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FREQUENCY CHANGERS VS. ALTERNATING MOTOR GENERATORS.

In large alternating-current systems with the various styles of duties and loads which they are now called upon to perform and carry, it seems to be considered impracticable to settle upon any one frequency for all parts of the system, and better to utilize at least two frequencies, with transforming devices connecting the two parts of the system. The advantages of a comparatively high frequency—sixty cycles or more—are briefly the comparative cheapness of transformation in small distributed units and the improved working of arc lights. For long-distance power transmission and for rotary-converter work lower frequencies—from 25 to 50 cycles—are better, owing to the reduced inductive drop and the lower peripheral speed of the rotaries. Comprehensive systems, therefore, occasionally adopt twenty-five cycles, for example, for part of their work and sixty cycles for the rest of it, and interconnect the two divisions either by means of alternating motor-generators or frequency changers.

The latter machines are not very widely known as yet and hence a brief description of their principle may not be out of place here. They consist essentially of multiphase primary and secondary windings on the opposite sides of an air gap, practically identical with those of an induction motor. With the movable portion of the machine stationary this gives a transformation of the same frequency with any desired voltage or phase changes, dependent on the winding and connections. By rotating the movable part in a direction the reverse of the motion of the rotating field the frequency of the induced secondary e. m. f. is increased by a percentage equal to the ratio of the mechanical speed to that of the primary rotating field. Rotation in the other direction reduces the frequency impressed upon the secondary. In one direction the mechanical rotation requires power and in the other generates power. By coupling such a machine to an alternating-current motor, either of the synchronous or induction type, the total power transformation is accomplished partially by magnetic and partially by mechanical means.

To illustrate the division of the load between the magnetic and mechanical transformation, and to show the necessary size of machines for a given output, the concrete example of the transformation of 120 kilowatts from 25 to 60 cycles will be assumed. This would require a generator constructed essentially like a 25-cycle 50-kw induction motor with a wound secondary and collector rings, the ratio of the secondary number of turns to the primary number of turns, if no change of the voltage is desired, being 5 to 12. This must be driven by a 70-kw motor, and if the primary of the induction generator has a 10-pole winding, giving its field a speed of 300 r. p. m., the motor must have fourteen poles, giving the shaft a speed of 214 r. p. m. It is interesting to note that it is impossible to use any smaller number of poles for this particular change of frequency. The change from 25 to 62½ is, on account of its more adaptable speed ratio, likely to be more frequently used, the minimum number of poles in this case being 4 and 6 for the motor and generator, respectively.

The same transformation can, of course, be effected by an alternating motor driving an alternating generator, in which case all the power transformed is by the one machine turned into mechan-

ical power, and by the other restored into electrical power, requiring, therefore, in the particular instance of transformation from 25 to 60 cycles, machines with a capacity 70 per cent. greater than by the other method. In certain instances the motor-generator method has a great advantage in that the voltage of the output is practically independent of that of the input. In the case of a synchronous motor the speed is independent of the voltage of power delivered to it within considerable limits, and the pressure of the generator which it drives is, of course, affected from the driving circuit only by variations in speed. If the motor of the transforming set is of the inductive type practically the same condition exists, as the speed of an induction motor is not greatly affected by changes of voltage within the limits ordinarily found in commercial work.

In a frequency generator, however, the voltage of the output is not only dependent upon the speed, and, therefore, upon the frequency of the input, but is directly proportional to the voltage of the latter, in that the intensity of the rotating field of the induction machine is exactly proportional thereto. In cases of long-distance power transmission where the line drop is likely to be a variable quantity owing to fluctuating loads, and where a steady voltage is desired for lighting service, the motor generator is preferable in spite of its increased cost and losses. Where, on the other hand, the regulation of the power delivered to the transforming set is as good as that desired at the lamps, or where line drop does not vary too rapidly to be followed by the switchboard attendant, the frequency changer is preferable owing to its lower cost and lower losses.

The frequency changer, however, introduces into the system a transformation across an air gap which requires lagging or alternating currents for its magnetization. With the use of a synchronous motor leading wattless currents can be introduced to counterbalance these, although this requires the use of an exciter. The frequency changer driven by an induction motor requires no direct-current apparatus whatever, while a motor generator requires, of course, direct-current excitation for at least one of the machines.

THE RATIO OF DYNAMO TO TURBINE POWER RATINGS.

In the selection of sizes of dynamos to be driven by water wheels the considerations are quite different from those involved in engine-driven combinations. The essential difference rises from the fact that water wheels will never much exceed their rated loads, being rated at practically wide open gate in order to have a high efficiency at their rated load. A slight margin, about 10 per cent., is allowed to make sure that the wheel will always carry its load with slight variations of head, etc. On this account turbines must always be chosen with a rated power equal to the maximum load they may be called upon to carry. Very brief overloads, that is, with a duration of a few seconds, may be carried by fly-wheel retardation, but for more protracted overloads there is no available source of energy.

Steam engines are also, as a rule, rated at or near their point of greatest economy which, instead of being the maximum possible output of the engine, is at a cut-off varying perhaps from one-quarter to one-half stroke. When called upon, therefore, the engine will take an overload of 50 or 100 per cent. without difficulty or harm other than a low steam economy. Thus, for fluctuating loads, such as those of street railways, the rated capacity of the engines in operation at any one time need not be more than, roughly, 60 per cent. of the load that may be thrown upon them.

Electrical generators have, as a rule, the same ability of carrying an overload, provided it is not continuous. Rated—as they usually are—upon their heating limit, they will stand excess loads of a magnitude somewhat in inverse proportion to their duration, limited only by the regulation, commutator sparking, etc. Thus, in choosing the size of a generator to carry fluctuating loads when steam-driven, the common practice of picking one with an output in kilowatts equal to three-quarters of the rated horse-power of the engine minus a few per cent. for internal losses is correct. But in the case of a generator to be turbine-driven on a variable load, the turbine must be chosen with a rated output sufficient to carry the maximum peaks, and the generator may well be of a much lower rating, since it can stand an overload which its driving power cannot. To take a concrete example, a water wheel rated at 1000 effective horse-power might well be expected to carry a 700-kw dynamo, but with a fluctuating load with peaks requiring 1000 horse-power at the shaft, a 600, or if a modern machine of high overload capacity, a 500-kw generator would do the same work at a lower cost and—in case the peaks were the exception and low loads the rule—with a greater efficiency.

Exactly the same consideration applies in gas-engine work. Gas engines, whether of the "hit-or-miss" or variable-charge style of governing, give their greatest efficiency with their greatest loads and are therefore rated very close to their maximum output, with a slight margin to assure their ability to carry their rating with slight changes of quality of fuel, etc. With perfectly steady loads driven either by turbines or gas engines, the common practice of rating is quite justifiable, but steady loads are the exception and variable loads the rule in electrical work, and the limitations of the driving source should be taken into account in the choice of sizes.

WHAT IS GOOD GOVERNING?

In the recently published catalogue of a prominent make of engine there are given some views on the subject of governing which, on account of the care and scientific comprehension of the subject evidenced in the get-up of the catalogue, merit notice. The catalogue compares the modern types of inertia governor, which, as it happens, were designed by Mr. Rites in the shops of this company, with the older double-weight types as follows:

"The new design has the features of greater simplicity and accessibility, and is capable of giving that ultra close regulation which is just now a somewhat popular fad. It is possible to adjust this governor so that there is no apparent difference in speed, whether the engine be running empty or fully loaded, and it is even possible to adjust it so that the speed with the engine fully loaded is 1 or 2 per cent. greater than when running empty. Being able to demonstrate that we can produce this sort of regulation, we may be relieved of any suspicion of unfairness or envy when we say it is a freak and of no commercial value. Perfect steadiness is the first requisite of a good governor, and a slight falling off in speed with increase of load contributes to that quality. We regularly adjust all governors to regulate within from 1 to 2 per cent. In the midst of so much clamor about 'marvelous governors' and 'perfect isochronism' the purchaser must be careful that his attention is not diverted from the features that are of real importance. We do not know of a single manufacturer with any claims to prominence who builds an engine that does not regulate sufficiently well for any commercial purpose."

So long as governing is effected by the variations of centrifugal force, close speed regulation will necessarily involve considerable unsteadiness, since the slight drop of speed which is bound to occur with load variations before the governor can correct it is enough to throw the weights through their whole range of action. To the statement that a slight falling off in speed with increase of load contributes to steadiness might be added the fact that a greater falling off in speed contributes still more to that quality. Where unsteadiness gives considerable trouble, as it does in isolated plant work with electric elevators, it might be well to look into the merits of governors with poor regulation balanced by generators with extra heavy over-compounding.

The Effect of Silicon on the Magnetic Permeability of Cast Iron.

BY F. C. CALDWELL.

The tests from which these results were obtained were made under the direction of the writer, as material for a thesis by J. M. Hipple and S. R. Hewitt, students of the Ohio State University. The opportunity was offered by a series of tests made by C. W. Weick, of the university, on the effect of silicon on the mechanical

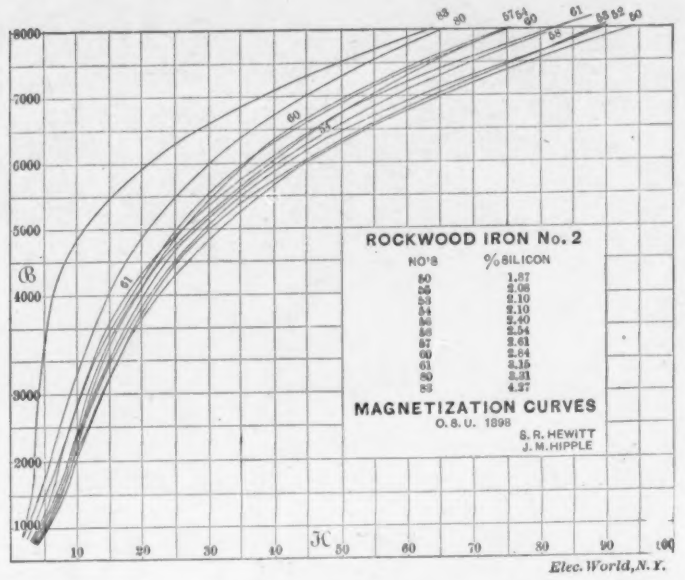


FIG. 1.

properties. These tests were made upon castings poured from a small cupola, the variation in silicon being obtained by the addition of silvery iron. Three different grades of iron were tested, but enough results to draw curves from were obtained from only two; the points obtained on the third, however, agreed fairly well with the curves here given.

The two irons of which the tests are given were "Rockford" No. 2, and "Bessemer"cast irons. The tests were made by the double yoke method, eliminating the error due to the yokes by the arrangement suggested by Ewing.* The bars were about 6½ inches long, and were set 3½ inches apart in yokes 1¾ inches by one-half inch. The maximum distance between the yokes was 12.56 cm. The bars were turned from ⅝-inch castings accurately to ⅜-inch diameter.

The iron of each heat was analyzed under the direction of Prof. N. W. Lord, of the university, and the percentages of silicon given

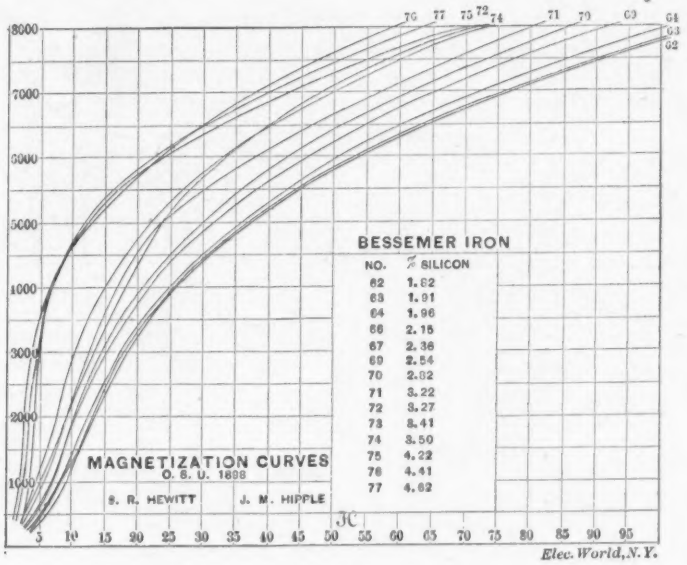


FIG. 2.

are from his report. The complete curves for all the samples were drawn, and are shown together in Figs. 1 and 2 for the two samples. From these curves the magnetizing forces necessary to give densities of 2000, 5000, 7000 and 8000 were obtained and plotted with percentages of silicon and are given in Figs. 3 and 4. These show that, at least in the irons tested, and in samples of the size used, the specific reluctance is decreased by the increase of silicon between 1.8 per cent. and 4.6 per cent., and that for low densities this decrease follows approximately a straight line law. Also that the same holds up to about 3.5 per cent. for densities up to 8000. Above this point with the higher densities the increase of silicon probably produces much less effect, the curves seeming to become nearly horizontal; indeed, comparison with the mechanical properties would indicate that further increase of silicon would probably produce a decrease in the permeability. It is also to be noted that the change in units of ℌ for each per cent. of silicon increases as the density increases, and that they are approximately the same in both irons tested, as seen in the following table:

Density,	2000	5000	7000	8000
Rockford No. 2	3.5	7.3	13.2	19.0
Bessemer	3.7	9.3	14.1	20.8

As would be expected from these results, the curves of permeability with percentages of silicon approximate to hyperbolas, the increase of permeability with addition of silicon being very marked at the lower densities.

It is interesting for comparison to note that according to Mr. Weick's tests the addition of silicon up to about 2½ or 3 per cent. softens the iron by change of combined carbon into graphite, but that further increase of silicon results in an increase of hardness. It would seem, therefore, that the maximum permeability requires

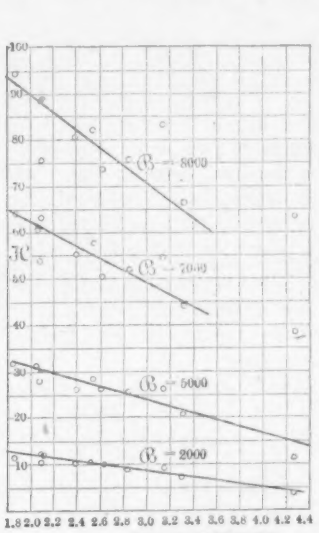


FIG. 3.

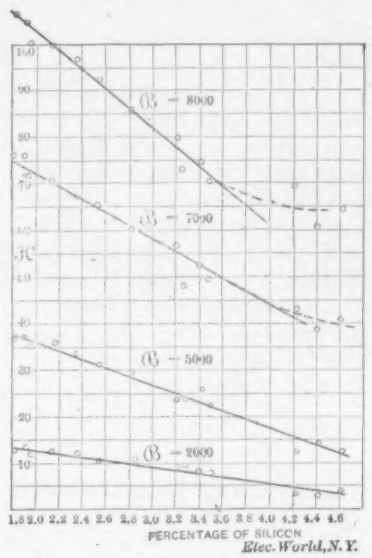


FIG. 4.

more silicon than that which gives the greatest softness. This, however, is a point that should be further investigated.

With regard to the irons tested, the Bessemer is a mixture of Lake Superior ores, and is made especially for use in the Bessemer process. The Rockford iron comes from Tennessee and is intended for grey castings.

*See THE ELECTRICAL WORLD, Vol. 28, page 695.

X-Ray Experiments.

An odd line of investigation to determine whether X-ray effects are or are not, as has been suggested, caused by the actual projection of material particles through the glass walls of a Crookes tube, and also through other substances, has been carried out by Prof. F. E. Nipher, of the Washington University, of St. Louis. A projection of molecules at a velocity as nearly as possible comparable with that in Crookes tubes was effected by rifle discharges, and the rather crude experiment of firing 3000 blank charges of smokeless powder at a sensitive photographic plate protected by a sheet aluminum and wooden shield was tried with no evidence of action on the plate. Professor Nipher now proposes to get a rapid-fire gun to imitate Crookes-tube conditions a little more closely by such a succession of charges as to keep the aluminum target red-hot.

What Shall Conduits Under Rivers Be Called?

The London "Electrician," in speaking of some draw-in conduits under rivers, carried the application of the Latin to the terminology of conduit work, as exemplified in the terms submarine and subterranean, one step further by the use of the adjective "subfluvial."

The Transmission Plant of the Cataract Power Company, Limited, of Hamilton, Ontario.

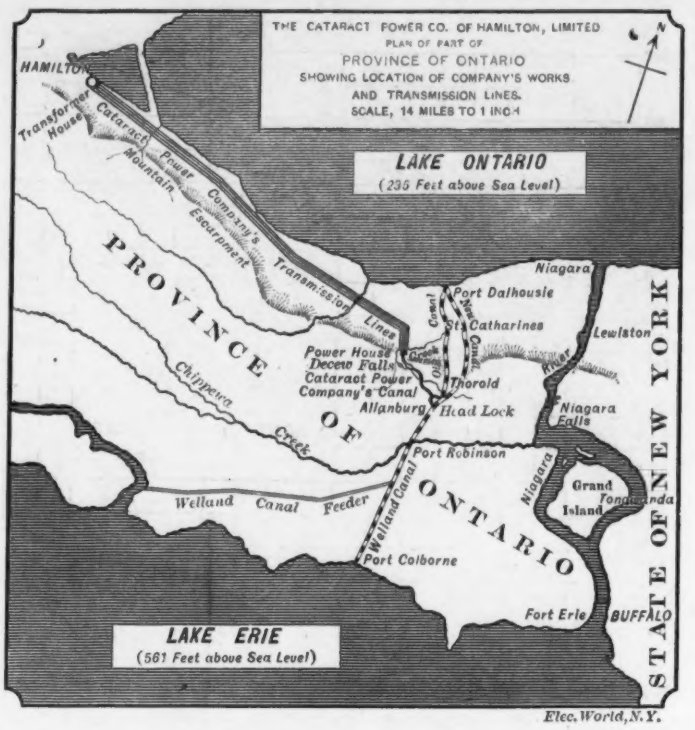
THE longest transmission of power and the highest voltage in regular service east of the Rocky Mountains is that of the transmission plant of the Cataract Power Company, of Hamilton. The generating plant is located at Decew Falls, about 12 miles west of Niagara Falls and a few miles south of the shore of Lake Ontario. (See map on this page. This point is 35 miles distant from Hamilton, to which place the power is transmitted. The system has been in service since the 1st of November, and was officially opened on November 12.

The power is really a part of that of Niagara Falls, the water being taken from Lake Erie and discharged into Lake Ontario, the immediate source being a feeder of the Lake Erie level of the Welland Canal, from which the water is taken at Allanburg. The power-house stands at the foot of a high escarpment, which can be traced for many miles east and west, and which forms the edge of the tableland that serves, so to speak, as a dam for the waters of Lake Erie, and through which the Niagara stream has cut its famous gorge.

THE HYDRAULIC EQUIPMENT.

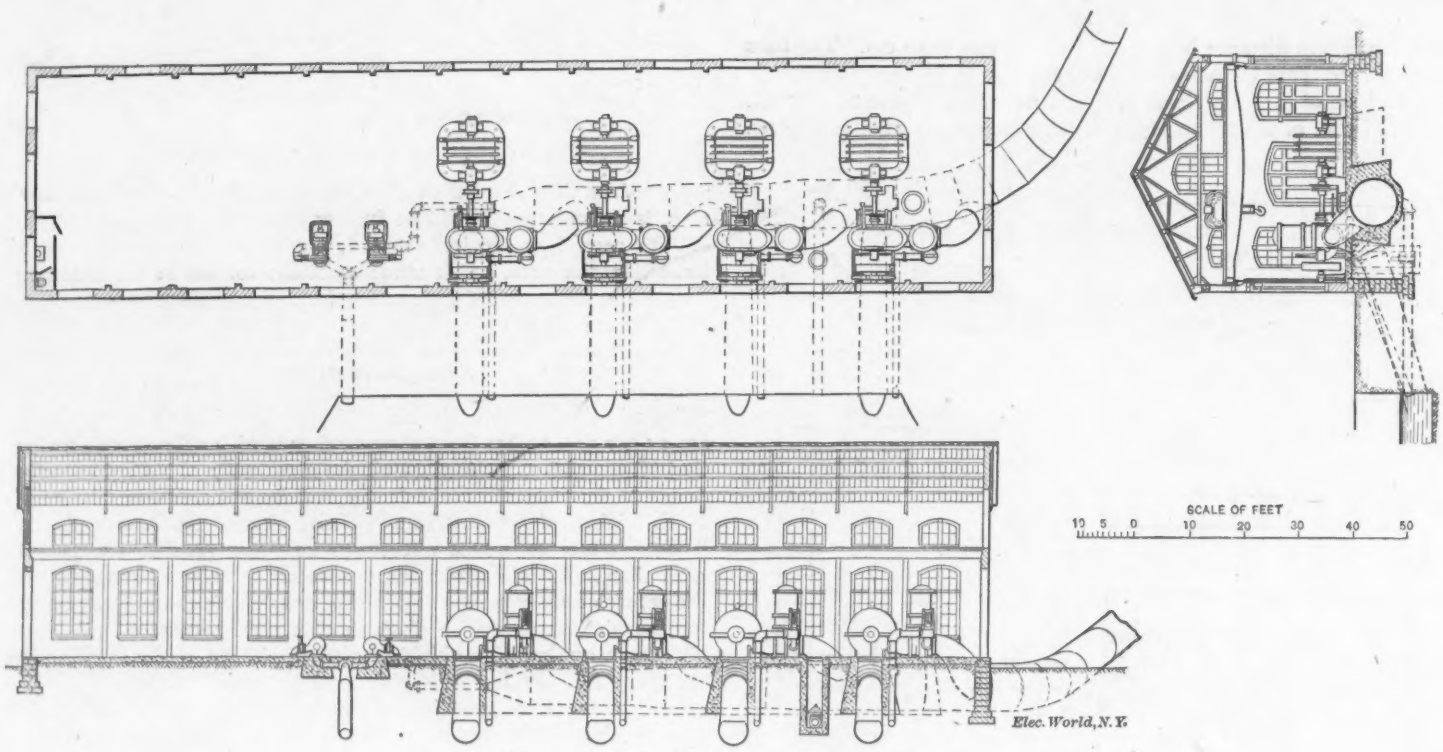
The water is brought from Allanburg to the edge of the escarpment by a canal about 4⅓ miles in length, cut in the clay, with a minimum cross-section of about 97½ square feet below the water level, the canal being 13 feet wide at the base, the sides having a 1½ slope and the normal depth being 5 feet of water. At one point a valley is crossed by a trestle-work carrying a rectangular, closed, wooden flume, which is maintained under a slight head to keep the whole of the flume wet. At the lower end of the canal there are three storage reservoirs, one natural and two artificial, giving an aggregate surface for storage of one and one-quarter million square feet area.

From the forebay the water is carried down the inclined surface of the escarpment to the power-house in a steel penstock 750 feet in length; the diameter of this pipe varies from 7½ to 8½ feet, and on account of its great size and weight the solutions of the various problems involved in its construction are interesting. It is supported entirely from the upper end, where it is securely anchored in a rock cut by means of having flanges built in concrete. This arrangement was made necessary by the lack of proper anchorage



THE LAKE ERIE-LAKE ONTARIO HYDRAULIC POWER DISTRICT.

points at the bottom of the slope. About two-thirds of the way down the hill there is a horizontal shelf, and at this point there is placed a slip joint to allow for temperature changes. This joint, in addition to taking care of the expansion and contraction, is so designed as to support that portion of the pipe below it, so that the whole pipe expansion, joint and all, is hung from the top. The pipe is not buried, but is supported on a concrete bed, about one-third of its diameter being below the surface, and will be covered



PLAN AND ELEVATIONS OF POWER HOUSE.

with a wooden sheath to prevent the formation of ice at times of light load.

THE POWER HOUSE.

The power-house, nestling in the valley of Twelve-Mile Creek, into which the tail-water discharges, is a plain brick structure, 174 feet long and 42 feet wide, covered, with a roof supported on steel trusses. The penstock receiver runs under the floor with four vertical branches curving over in quarter turns to the main wheels, and beyond them two similar branches for the exciters. (See plan and elevations on opposite page). Two of the main wheels and the two exciters are already in place.

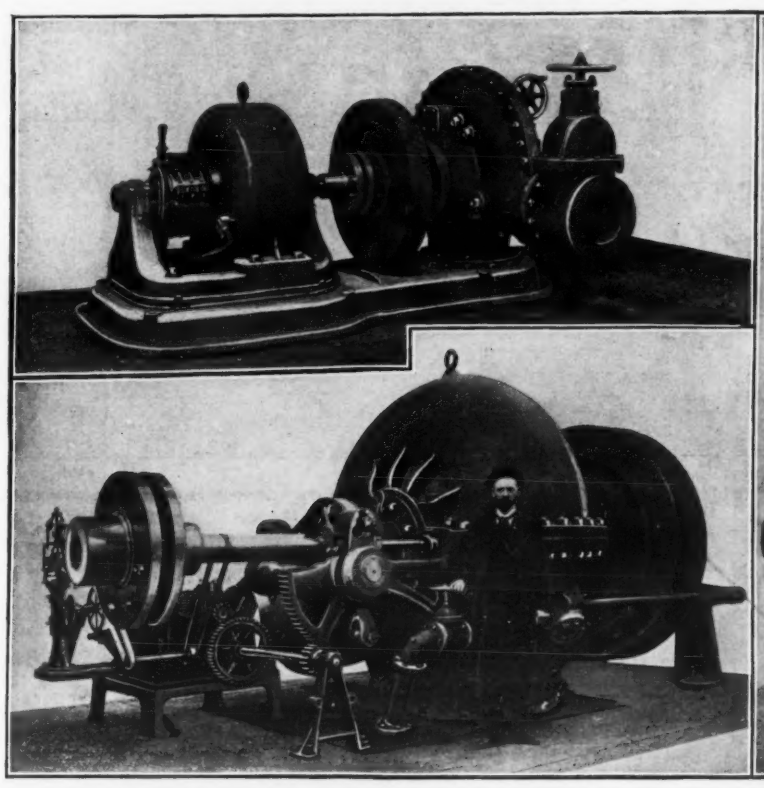
THE SLIP-JOINT, PENSTOCK AND POWER HOUSE.

The main gates, one of which is shown in the accompanying illustration, are 36 inches in diameter, and were built, as were the wheels, by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. They are each operated by a hydraulic ram under penstock pressure, and are not fitted with by-passes. The four-way valve for operating the ram is moved by a long handle, as shown in the illustration. On the other side of the ram is a 12-inch spring-closed relief valve, there being no air chambers on the penstock.

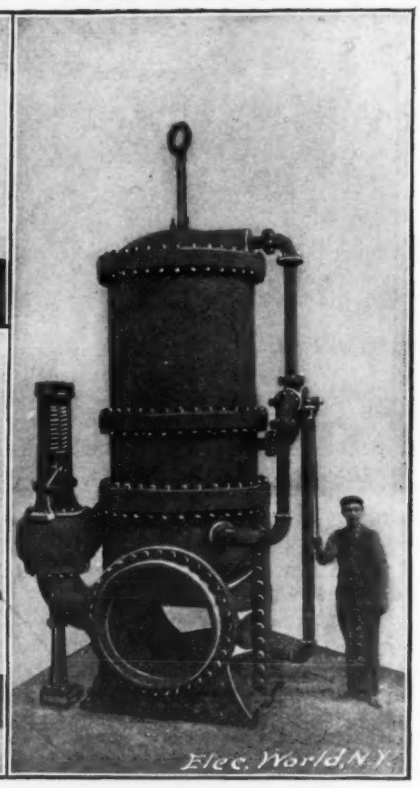
The wheels are of a different style from those generally put out by this company, and may be described as an inward-flow, radial type. One of the interesting engineering features of this plant is that it is the highest head on this continent employing the reaction type of turbines. The high-head plants in the Rockies all use impulse wheels. The intake pipe is horizontal, and the draft tube passes vertically down through the floor and is sealed in the tail-race to give the added head of 14 feet by suction. The governing gate is a ring of the register type, between the guide chutes and the buckets of the runner, and is moved axially by two rods connected with the governor mechanism. The governor is of the Giesler electro-mechanical type, the centrifugal balls operating electrical contacts, the currents from which in turn energize clutches which are driven by belting from the main shaft. The wheels are rated at 1950 horse-power each at 400 r. p. m., under the normal head, which is about 260 feet.

On one of the shafts is a 7½-ton fly-wheel, with an outboard bearing, and the other end is attached through an insulating coupling with the electrical generator. The latter are of the inductor type of the S. K. C. design, and were supplied, as was all the electrical equipment, by the Royal Electric Company, of Montreal. The inductor weighs 15 tons, and is fitted with ten poles on each ring, and therefore, at the speed of 400 r. p. m., generates 66 cycles per second, or 8000 alternations per minute. The machines generate two phases at 2000 to 2400 volts, the windings being, as is customary with these machines, of the coil type not distributed. These coils are wound of bare copper strip with mica insulation between the turns, which construction will stand long-continued over-heating without deteriorating.

The machine switchboard is a handsome piece of work, with three panels of white marble, one for the exciters and one for each of the generators now in place. The generator panels have no live contacts on the face of the board, and are each equipped with one voltmeter and switch by which it may be thrown onto either phase, two main ammeters, one for each phase, and one direct-current ammeter in the field circuit. Switching is accomplished by two double-pole, double-throw slide switches, one for each phase, the double throw being from one set of bus bars to the other. Beside these instruments there are the usual field rheostats. There are no fuses on the generator-board, a short circuit being considered less dangerous with these machines than a sudden throwing off of the load by a fuse blowing with the turbine-gate full open. The exciter panel contains the usual instruments and switches for operating two direct-current shunt machines in parallel on the exciting buses.



ONE OF THE EXCITER SETS.
ONE OF THE MAIN WHEELS WITH GOVERNOR, FLY-WHEEL AND COUPLING.

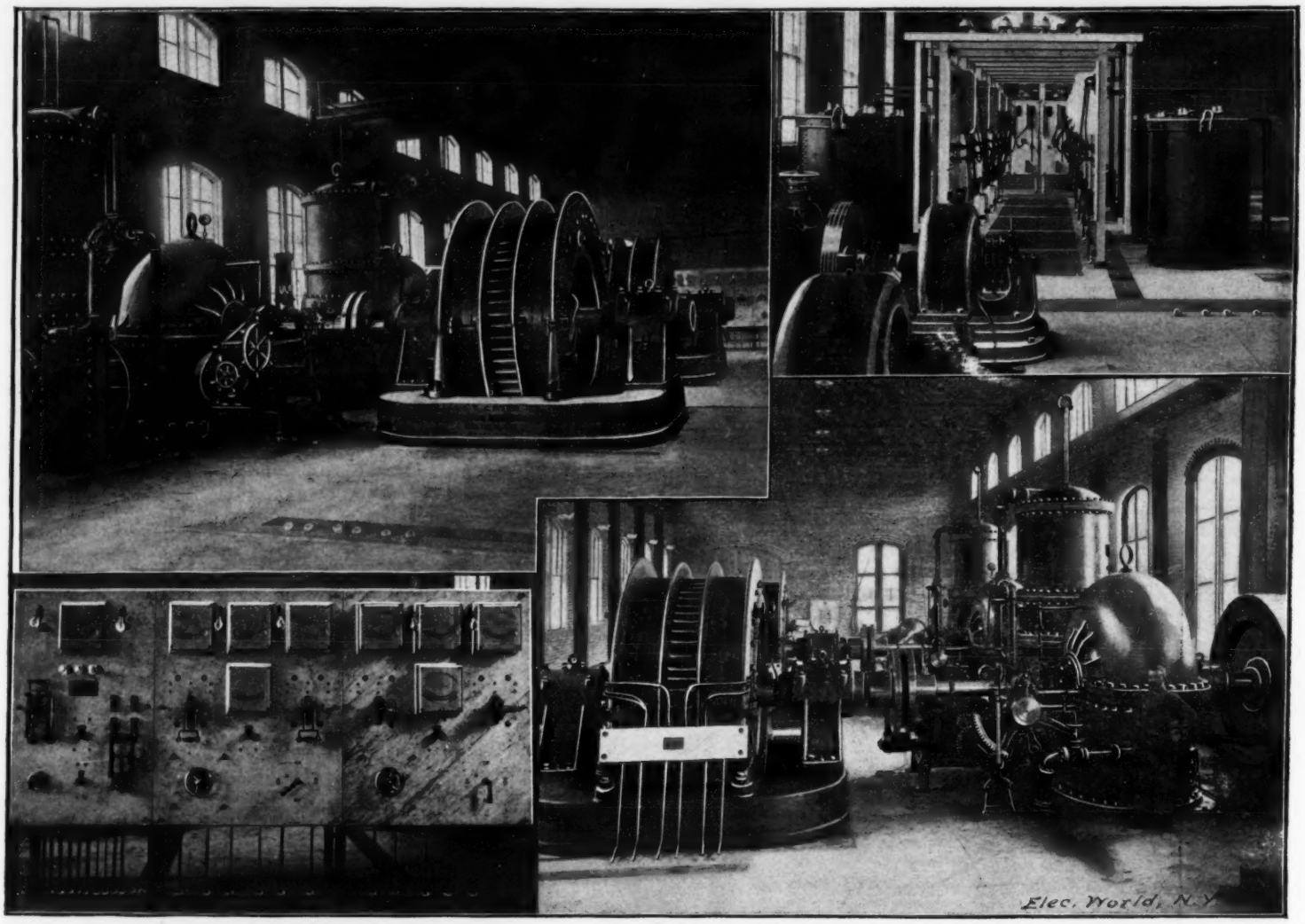


A VIEW OF ONE OF THE MAIN GATES, SHOWING RAM AND RELIEF VALVE.

The exciters themselves consist of two 30-kw, four-pole, 70-volt machines, built by the Crocker-Wheeler Company, driven at 1000 r. p. m. by individual turbines to which they are direct-coupled, each exciter unit being of sufficient capacity to excite the full equipment of four generators. These turbines are hand-governed.

One of the most interesting parts of the station is that devoted to the step-up transformers for obtaining the 20,000 to 24,000 volts delivered to the line. Two-phase currents are used on the line, so that no transformation of the phase relation is necessary, and a plain battery of single-phase transformers is used on each phase. Each battery consists of five 200-kw Stanley transformers, immersed in mineral-seal oil in heavy boiler-iron cylindrical cases about 4 feet in diameter and 6 feet in height. The transformers are water-cooled, the water, which is taken from the penstock, being circulated through pipes inside the transformer cases themselves.

Each transformer is fitted with a marble switchboard supplied with switches on both the high and the low tension sides; the latter are the ordinary slide type, double-throw from one set of bus bars to the other, and mounted on the backs of the panels. The 20,000-volt switches are more interesting. They are of what is called the stick type, consisting of a wooden pole about four feet long, carrying at its upper end a receptacle or socket which may be pushed up around a downwardly projecting contact finger on the board. The socket on the pole is connected by a heavily insulated, flexible cable with a plug, which is permanently screwed into its receptacle. The socket is provided with guides which run under hard-rubber slides when the socket is attached to or removed from the finger. The tips of both fingers and sockets are made of non-arcing metal. It is not intended that these switches shall be opened with the load on, but the load will first be removed by the low-tension switches. The others will then only open the magnetizing current of the transformers and the capacity current of the line. Each high-tension stick may be attached to either one of two fingers, connecting to either one or the other of the duplicate lines which will eventually be established. Between the two poles of the switchboard for each transformer there is a heavy marble barrier. Non-arcing fuses are placed on both primary and secondary sides of each step-up transformer.



The Interior of the Power House.
The Machine Switchboard.

The Transformers and High-Tension Switchboard Alley.
Another View of the Main Sets.

THE LINE.

The line, as noted above, is of a rather unusual type for such long transmissions—namely, two-phase. The 25 per cent. economy of copper which could have been obtained by a three-phase line with the same potential difference between wires is sacrificed for the reduced interference of unbalanced loads which will be obtained by the arrangement adopted. The four No. 1 medium-drawn, bare copper wires are supported on a single cross-arm, the two phases being respectively on the two sides of the poles, the wires being 18 inches apart. The poles vary from 40 to 50 feet in length, have tops with a minimum diameter of 8 inches, and are spaced 90 feet apart.

Protection against lightning is obtained by a barbed wire the whole length of the line stapled to the tops of the poles and grounded at each pole. At the terminals banks of Stanley lightning arresters and choke coils are used, there being thirty gaps in series between each wire and ground. The insulators are triple-petticoat porcelain, made by the Imperial Porcelain Works, and tested in the ordinary way to 65,000 volts before use. The pins are of locust prepared in oil and are fastened into the cross-arm with a wooden peg, the object being to avoid all unnecessary metal near the wires. A two-wire telephone line is mounted on a lower cross-arm and is frequently transposed, the power wires not being transposed or spiralled. For a large part of the distance the line follows the route of the Grand Trunk Railway, and electrical engineers traveling over this road between the East and the West will be interested to see this visible evidence of high-voltage transmission.

THE TRANSFORMER SUB-STATION.

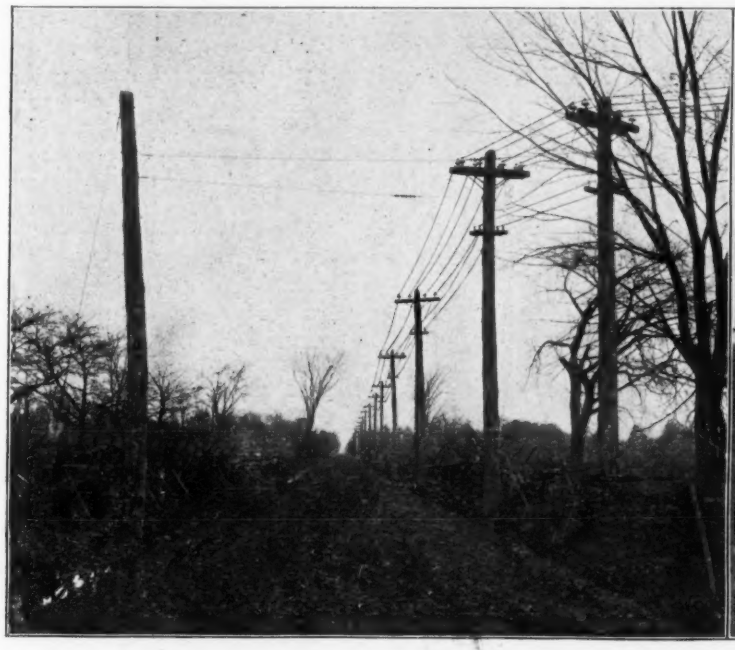
At Hamilton the line runs into a specially constructed brick transformer station on Victoria Avenue. After passing through the ar-

resters each wire terminates in a panel of the line board provided with stick switches as at the other end. One-half of the room is occupied by two batteries of five 175-kw transformers, similar to those at the power station, except that they are air instead of water cooled. The boiler iron cases are fitted with a ring of vertical tubes open at either end, and the transformers set over a duct into which air is blown by a Sturtevant blower coupled to an S. K. C. two-phase motor. The air rises through the tubes and discharges from the tops of the cases, cooling the oil, which in turn cools the copper and iron of the transformer. Each transformer is fitted, as are those at the power station, with switchboard panels having high-tension and low-tension switches. The high-tension side is also fused at this point with D. & W. enclosed, 20,000-volt, 13-ampere fuses 15 inches in length.

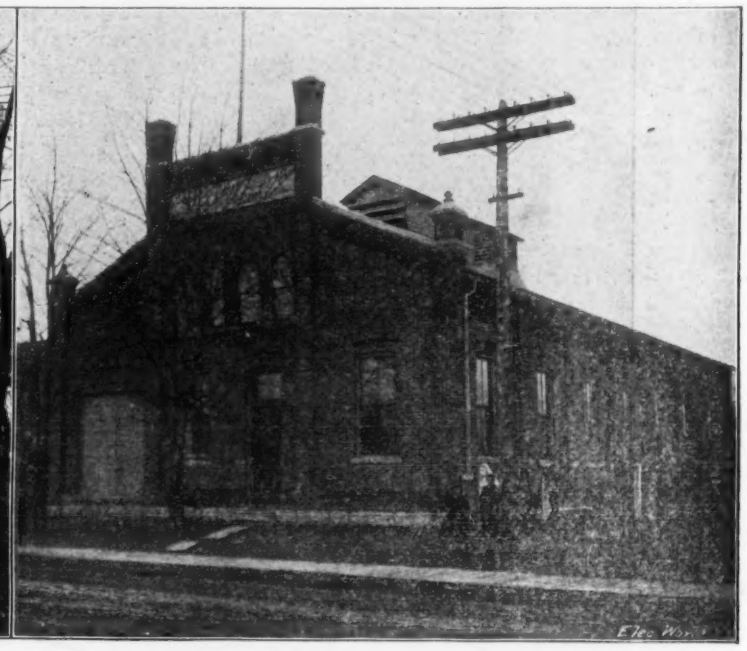
The company is now supplying power to the incandescent service of the Hamilton Electric Light & Power Company, and for the outgoing 2000-volt feeders still another switchboard is in use at the transformer sub-station. These feeders are provided with two independent wires on each phase, except those which will be devoted exclusively to power service, which will have three-wire, two-phase lines. The lighting loads are balanced and boosted at the Electric Light Company's station. The old house-to-house 1000 to 50 volt, 16,000-alternation transformers of the lighting company have been replaced by 2000 to 100 volt, 8000-alternation transformers in larger units, with a better grouping of the secondary loads. The company expects later to carry a considerable power load to drive the arc-light machines and also several, if not all, of the street railway lines of Hamilton, and certainly deserves a full measure of success for the boldness and skill with which it has met the difficulties that have stood in its way.

The officers of the company are Hon. J. M. Gibson, president; John Moodie, treasurer; John Patterson, secretary, and H. R. Leyden, general manager, the latter having had general charge of all the construction operations.

The canal and hydraulic work has been performed under the direction of William Kennedy, Jr., consulting hydraulic engineer, and Thomas E. Hillman, engineer in charge of canal construction. The principal contractors were A. A. McDonald & Co., earthwork, canal, etc.; Lowe & Farrell, pole lines; the Stilwell-Bierce & Smith-Vaile Company, hydraulic machinery and pipe, and the Royal Electric Company, electrical equipment.



THE 20,000-VOLT TWO-PHASE POLE LINE.



THE STEP-DOWN TRANSFORMER SUB-STATION.

Electric Railways Here and Abroad.

In a recent address, Mr. W. H. Preece, of London, said: "When I visited America in 1884 there was only one experimental line at work in Cleveland, Ohio. Now there are more miles of line so worked in Cleveland alone than in the whole of the United Kingdom."

The Mechanical Plant of a Modern Commercial Building.

A complete description of the design—with a discussion of various reasons for each detail—of an isolated plant in a modern office building is given by Mr. William H. Bryan in a paper presented at the recent meeting of the American Society of Mechanical Engineers in New York. From this paper the following facts have been abstracted:

The building is that of the Commerce Realty Company, St. Louis, Mo., eight stories in height besides the basement, and occupying a ground space 109 x 225 feet. It is occupied by a large drygoods house, the floors being divided by partitions. After discussing the considerations involved in the planning of different parts of the equipment, the author takes up the subject of contracts and prices, which is quoted as follows:

In view of the central location and general character of the building and its tenants, and the fact that the installation was intended to be a model one, there was great competition for the work. Furthermore, as all bidders were figuring on practically identical specifications there was no chance to claim advantages due to superiority of apparatus or methods. The figures, therefore, were strictly comparative.

On account of this competition the work was let at exceedingly low figures, as will be seen below, the usual profits being cut out, and, in some instances, losses sustained. These figures should, therefore, be used with caution, and from 10 to 20 per cent. added when estimating the cost of new work. Due allowance should also be made for differences in the character of buildings and the service rendered as determined by the peculiarities of the business carried on in it. This is wholly a question of experience and judgment.

The owners of the building under consideration did not feel warranted in supplying their tenants with a high-grade plant, claiming that the lease did not require it. As the tenants had made a ten years' lease, however, and would have to meet the fuel bills, they agreed to pay part of the extra expense.

It was not definitely decided to put in a complete plant until final bids were in, and estimates of cost of operation, repairs, and maintenance had been made. Up to that time the securing of all electrical—and even steam—service from a central station was under serious consideration. The figures, however, showed a material saving by operating their own plant, due principally to the use of exhaust for heating.

Compound engines and electric elevators having been selected, requiring 303 boiler horse-power, it was thought safe to reduce the boiler capacity to three units of 150 horse-power each, two to do the ordinary maximum service. This was equivalent to 4955 pounds of water per hour per boiler, from feed of 212° Fahr. into steam of

125 pounds gauge pressure. Water-tube boilers proving not as high in price as expected, that type was selected, the boiler being the "O'Brien," made in St. Louis. This boiler is similar to the Heine, except that the steam and water drum is horizontal, and not parallel to the tubes; the front and rear water legs are wider at the top than at the bottom, and the rear leg extends some distance below the lower tubes, as a settling chamber. Each boiler contained 1141 square feet heating surface, including drums and tubes of the Hawley furnace, or 9.4 square feet heating surface per horse-power. The grate surface (upper grates only) was 31.5 square feet; ratio grate to heating surface, 1 to 45. The cost of the three boilers set up, including Hawley furnaces, brickwork, foundations, and smoke flue, was $6288, being $13.97 per horse-power, or $1.48 per square foot of heating surface.

The cubic feet of gross capacity of building—as usually computed by architects from outside lines, and from bottom of footings to top of roof—per rated boiler horse-power is 6771; and 5146 cubic feet of space is heated per boiler horse-power. The space heated included only the actual indoor space, and omitted basement.

This work, as well as the heating system and large pipework, was let to Kupferle Brothers Manufacturing Company, of St. Louis, at the gross price of $16,511.

The lowest bid on ordinary boilers, as per specifications, was $5997, being $3397 for the boilers, and $2100 for the Hawley down-draught furnaces, and $500 for the brickwork. The four boilers aggregated 524 horse-power. The price quoted was, therefore, $11.44 per horse-power, or $0.95 per square foot heating surface.

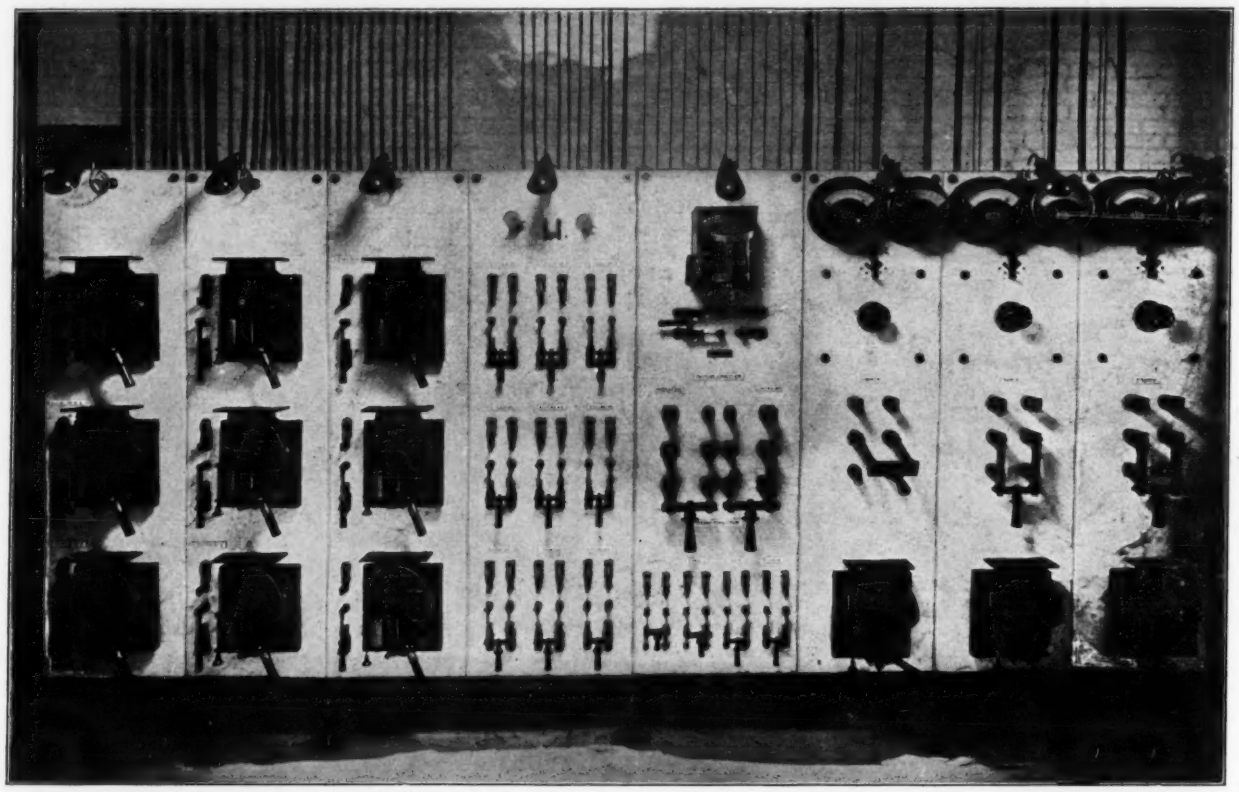
The selection of the elevator system presented the greatest difficulties. The bids based strictly on the specifications seemed excessive in price, and the owners directed that the data be revised, with a view of getting more reasonable figures. The capacity of the elevators was therefore reduced. The two passenger and two southwest freight elevators had their average loads cut down to 1500 pounds, and the four north machines to 1800 pounds, being required to carry these loads at the speeds specified. They were also to be capable of carrying the larger loads originally specified, at reduced speeds. Wooden guide posts and strips were substituted for the steel T guides. The allowance for passenger cabs was reduced to $200, and the indicators omitted.

On this revised basis the Sprague system was selected, at the price of $22,070, including ash-hoist and safety gates. This low price was due partly to the conditions already named, and was made possible by arrangements made with local parties for erection, under a Sprague expert. The four north elevators were to be of the "X 38" type, with solenoid control, and the four south elevators of the "Z" type, with pilot-motor control.

To the above price should be added $3134 for the cost of third engine and dynamo, etc., making a total of $25,204 for the elevator plant complete. The cost per cubic foot of building space (gross) for elevators alone was $0.0072, and for elevators, with engine, dynamo, etc., $0.0083. The cost per square foot of total floor space was: for elevators alone was $0.0072, and for elevators, with engine, dyna-

The selection of the electric elevator for this important installation was decided upon after a thorough investigation. They were found to be more economical in fuel than any other type—even the high-duty hydraulic—on account of the light loads usually carried, and the corresponding saving in power. There was also some saving in first cost. The electrical plant afforded a much more compact arrangement in engine room. As no pumping engines were required, and no tanks or accumulators, one reserve unit answered for both the lighting and elevator plants. The electric elevator has not as yet fully established its reliability and low repair account as well as the hydraulic, but the latest and best types seem to leave but little to be desired in these directions.

The steam elevators were, of course, the lowest in first cost, but were not given serious consideration on account of their large fuel consumption.



A View of the Main Switchboard.

General Electric dynamos were selected, the guaranteed efficiencies being:

At ¼	load	84.0 per cent.
" ½	"	89.5 "
" ¾	"	91.5 "
" full	"	91.5 "

The three 75-kw generators, with switchboard,* etc., as specified, cost $5135, or $22.80 per kilowatt. Speed, 260 r. p. m.

Gross cubic feet cared for per kilowatt of dynamo capacity for lighting... 20,312
Gross cubic feet cared for per kilowatt of dynamo capacity for all purposes. 13,541

The three 125-hp engines selected were of the Imperial compound type, built by the Weston Engine Company, of Painted Post, N. Y. Dimensions of cylinders: high pressure, 12 inches diameter; low, 20 inches; stroke, 14 inches; speed, 260. Price, $4268, or $11.38 per indicated horse-power. The same builders offered three simple engines, 15 inches x 14 inches, for the same service for $3616, or $9.64 per indicated horse-power. This should be reduced about 5 per cent. to be strictly comparable with the cost

*The switchboard was built by the Emerson Electric Manufacturing Company, St. Louis.

of the compounds. Computations showed that the horse-power hours of service per year would be sufficient to make the fuel saving of the compound over the simple enough to warrant the additional investment.

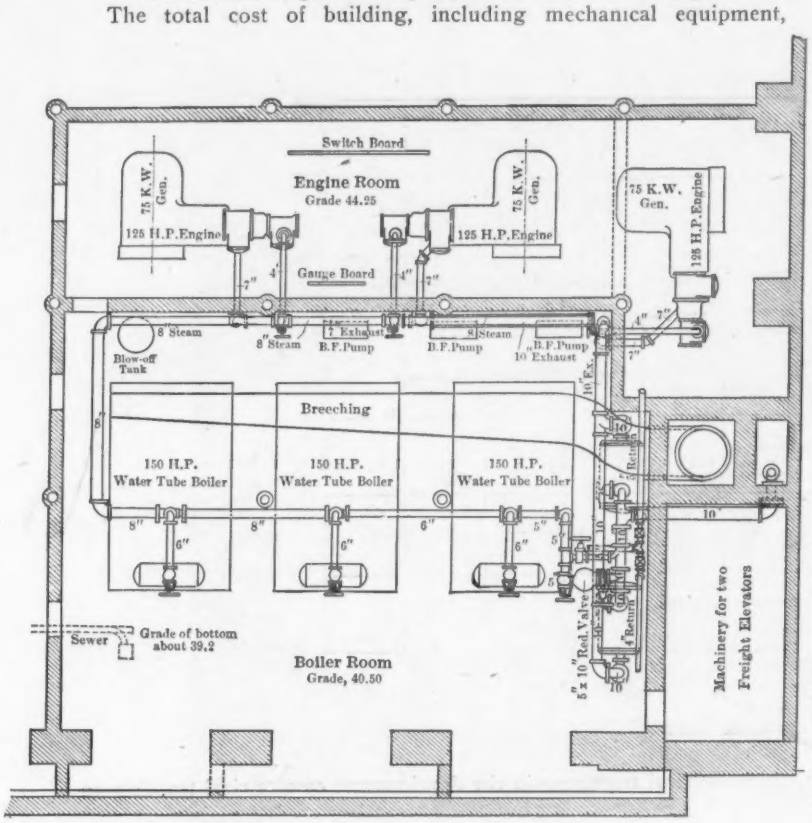
The cost of engines and dynamos together was $9403, which is $41.80 per kilowatt of dynamo capacity, and $25.07 per indicated horse-power of engine capacity. Gross capacity of building (cubic feet) cared for per horse-power of engine, 8125.

The wiring, lamps, fans and motors were let for $6315, in accordance with the specifications, to the General Electric Company, their 220-volt arc lamp being selected. On the basis of 150-kw capacity the price per kilowatt was $42.10, including the entire work from the switchboard to the lights and fans, exclusive of special fixtures on first floor. Adding to this two-thirds of the contract price for engines and dynamos gives the total cost of the electric lighting plant (exclusive of elevators) as $12,584, or $83.90 per kilowatt, exclusive also of boilers and piping.

The total cost of the mechanical plant ($54,209) may be divided as follows:

Per cubic foot of gross space	$ 0.0178
Per cubic foot of space heated	0.0234
Per square foot radiating surface contracted for	3.00
Per rated horse-power of boiler capacity	120.66
Per indicated horse-power of engine capacity	144.80
Per kilowatt of generator capacity	241.32

The total cost of building, including mechanical equipment, ready for the tenant's use, was $301,000, or 9.9 cents per gross cubic foot, and 13 cents per cubic foot heated. The cost named included $20,000 for the use of the party walls of the adjoining buildings, and $10,000 for Luxfer prism glass, and $9000 for a sprinkling system. The value of the ground was $200,000, making the total investment a trifle over $500,000.



PLAN OF BOILER AND ENGINE ROOM.

TESTS AND PERFORMANCE.

During construction and erection the work was under the supervision of the engineers, and on completion it was submitted to careful inspection and tests to determine whether the contract guarantees had been met. Since going into service the plant has been under the observation of the engineers, so that close track has been kept of its performance.

The boilers were submitted to a number of evaporative trials to determine their capacity and efficiency. The details are not given here, as the methods and results are of no special interest. The boilers, however, give good service, particularly in capacity, dryness of steam, and smokelessness.

An exhaustive detailed test of capacity, speed, and efficiency was made on No. 5 elevator, type "X 38," situated in the northeast shaft. Simultaneous readings at 2½-second intervals were taken of the voltage, speed, and current—the latter being checked by two instruments, two observers reading independently. The live loads upon the platforms were obtained by weighing.

The speed of travel was calculated by dividing the revolutions of the armature by the known ratio between speed of armature and speed of car. The power consumed per trip was obtained by plotting the curves of current readings (see figure), the area of which —multiplied by the voltage—gives the watt hours per trip. This was reduced to mile of travel by multiplying the watt hours per trip by the fraction that one round trip is of one mile. The following table gives the results:

Elevator.	Live Load, Pounds.	Speed Up, Ft. per Min.	Speed Down, Ft. per Min.	Kw. Hours per Car Mile.	Remarks.
Z, No. 1.	147	271	268	3.14	
" ..	908	256	256	3.14	
" ..	2,997	153	157	4.22	Slow speed.
" ..	2,997	256	290	4.19	High speed.
" ..	4,000	147	192	4.05	Slow speed.
X 38, No. 5.	147	153	153	3.14	
" ..	1,008	157	155	3.19	
" ..	4,000	152	160	3.34	
" ..	5,012	153	160	3.81	

The observed data from the "X 38" machine are plotted on page 626. It is interesting to note the current of return to the line with light loads ascending, and heavy loads descending. It will be noted that No. 1 elevator has a down speed, with operator only, of 268 feet per minute. With the same counterbalancing it carries a load of 3000 pounds up at 153 feet per minute, with motor operating on slow-speed notch of operating lever. When operated at high speed this elevator lifted 3000 pounds at a speed of 256 feet per minute, and with an economy per round trip slightly better than when operated at slow speed. This elevator carried 4000 pounds up at 147 feet per minute when operated on the slow-speed point of operating lever.

The No. 5 elevator has a down speed of 153 feet per minute when running with operator only, and carries its full rated load of 4000 pounds up at a speed of 152 feet per minute. This elevator carries 5000 pounds up at a speed of 153 feet per minute.

It is particularly interesting to note that the efficiency in kw hours per car-mile increased but slowly with increased loads. The kw hours per car-mile of travel are equal to good average practice, and will probably improve after longer operation of the plant.

The adjustment of the starting devices on the elevators was found to be for a two and a half to three seconds' start. This made the starting current exceed the running current by more than the 50 per cent. specified, which was based on a five seconds' start. When the starting devices were readjusted for a five-second start this condition of the specifications was practically met. It is a question of judgment, therefore, whether the tenants prefer a slow and easy start and a smooth-running electric plant, or a quick start and a correspondingly severe and sudden demand upon the dynamo and engine.

Two dynamos were operated in multiple, running both elevators and lights. With a variation of load from 250 to 600 amperes, the ordinary variation of voltage was from 220 to 226, and the maximum, 218 to 228. With a variation of load from 200 to 500 amperes the average variation of voltage was from 216 to 220, and the maximum, 214 to 222. This variation did not affect the lights sufficiently to be noticeable, unless the observer's attention was called to it, but has been further improved by a more careful adjustment of the elevator-starting devices.

The wattmeter on switchboard shows the electric power used by the eight elevators from July 12 to 27, 1898, inclusive, or 138½ hours' operation, to have been 1920 kw hours, or an average electrical horse-power per hour of 18.6 for the plant, or 2.3 horse-power per elevator.

During the month July 12-August 12, 1898, the hours of operation were 283.5, and the average electrical horse-power was 19.2, or 2.4 per elevator. Unfortunately no records were kept of the miles of travel during this time, but they may be roughly approximated as follows, taking the first period mentioned:

Assuming an average efficiency of four kw hours per car-mile, the 1920 kw hours mean a travel of 480 miles. The travel of the eight elevators per round trip is 1608 feet, or 0.304 mile. Dividing 480 by 0.304, the number of round trips is found to be 1579 in 1385 hours, or 11.4 per hour, or five and one-fourth minutes per round trip. As the average travel is about 201 feet, and the average speed about 200 feet per minute, the round trip should have been made in about a minute. This indicates that the elevators averaged about

one-fifth the time in motion, instead of one-third to one-half, as originally assumed for maximum service.

It is gratifying to note that the power actually required to operate the elevator plant is considerably less than originally estimated. This is due to the use of apparatus of higher efficiency than assumed, to smaller percentage of time in motion, and to the loads contracted for being less than specified.

The data in the following table, showing the relative performance of three elevator plants in St. Louis, will be found interesting. *A* and *B* are high-pressure hydraulic plants of the most modern type, plant *A* having a high-duty compound crank and fly-wheel pumping engine, and *B* an ordinary direct-acting compound pump. The Hagardine-McKittrick plant is shown in column *C*, and is furnishing arc and incandescent lights from the same bus bars. The fuel and water results are computed from the guaranteed efficiencies of boilers and engines, the elevator data, however, being based on actual test.

	A.	*B.*	*C.*
Cost of coal	$1.35	$1.50	$1.40
Water evaporated per pound of coal	8.00	8.00	7.64
Water required per i. h. p. hour	....	54.21	25.00
Coal " " " " "	....	6.78	3.27
Kw. hours per car mile—average load	....	....	3.165
Hp. " " " " " " electrical	....	....	4.24
" " " " " " indicated	....	....	5.30
Lbs. coal " " " " "	24.00	58.54	17.33
Cost of same—cents	1.62	4.39	1.21
Average i. h. p. per elevator July 12—Aug. 12, 1898	....	....	3.00
Cost of coal per elevator per hour—cents	....	2.92	0.69
" " " " day of 10 hours—average cents	....	29.24	6.87
Cost on basis of a round trip every 9 min.—cents	4.13	9.75	2.75

The unfavorable showing of plant *B* is due almost wholly to the low-duty pumping engine. The ordinary hydraulic plant using low-water pressures, and ordinary duplex pumps—sometimes not even compound—is still more wasteful in fuel. The favorable showing of the electric elevators is due to good counterbalancing, reduced power with loads under the maximum, and compound steam engines. The tests of kw hours per car-mile were made with stops and starts at terminals only. The power required will, of course, be larger when many intermediate stops are made.

Exhaustive tests were conducted on the dynamos, covering capacity, heating, efficiency and general operation, with varying loads, both under and above rating. Very satisfactory performance was found, and complete conformance with the rigid requirements of the specification. The efficiency of the generators at various loads was computed by means of indicator diagrams and switchboard readings, using carefully calibrated instruments.

The engines were tested for capacity, regulation, and general performance, and were found acceptable. The following results were secured:

Indicated horse-power	126.74
Electrical horse-power at switchboard	102.37
Efficiency of engine and dynamo unit—per cent	80.77
Water rate per indicated horse-power hour—pounds	26.79

The latter was a trifle higher than the guarantee of 25, but the test load was a little too large, and the engine was a trifle out of adjustment. The engine efficiency was determined by a four-hour trial, measuring the water which entered the boiler, and collecting the condensation in pipe system by means of separators, drains and traps, and deducting its weight from that of the water which had been pumped through the measuring tanks.

The Report of the French Railway Engineers.

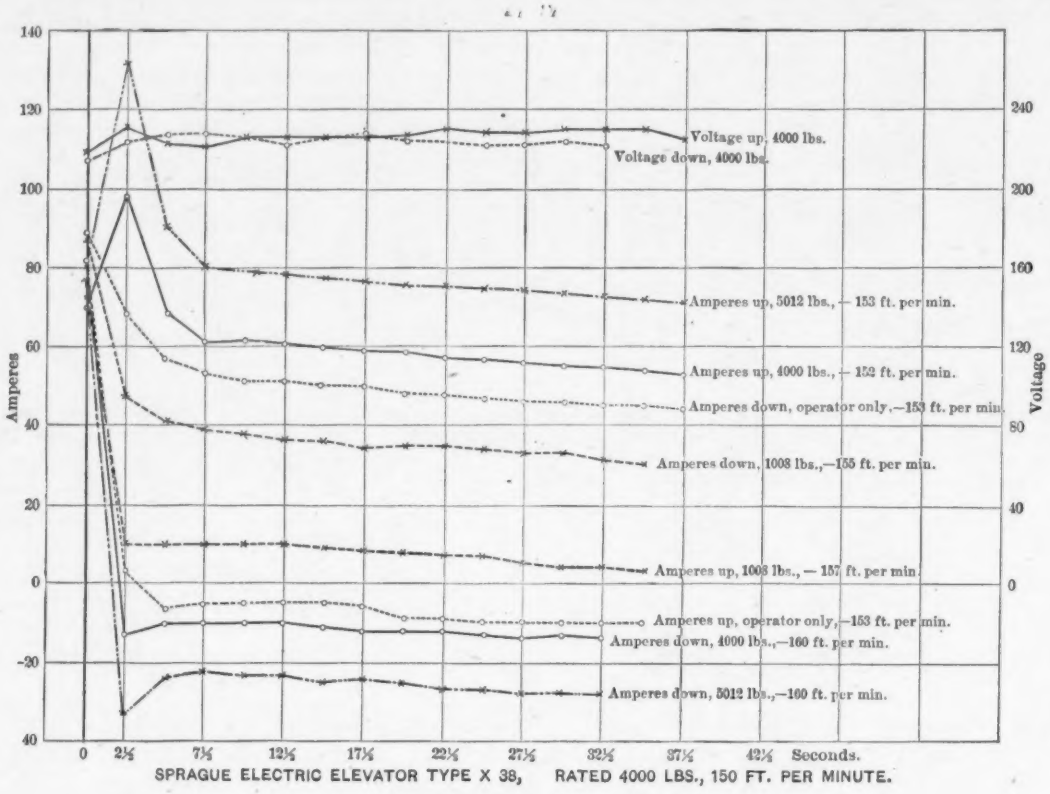
The report of the committee of engineers sent to this country by the Orleans Railway Company* to determine the status of the art of heavy electric traction, has recently been published, and while most of it is trite to American engineers, there are some examples of fine sarcasm and some interesting conclusions. The London "Electrical Review" quotes the following:

"While we are losing our time on the Heilmann locomotive, the Americans are utilizing, with success, experience gained in exploiting electrical tramways in the development of electrical traction on main-line railways, leaving the generating station at home."

A reference to English conservatism is given as follows: "In ten years electrical traction has almost entirely supplanted horse traction and cable lines in America. New lines have been established at the same time as electric lighting in small towns, in the suburbs of large towns, reaching out to distances impracticable for either horse or cable roads, uniting the principal localities at 40 to 50 kilometres apart, and endeavoring by the junction of suburban networks to raise up traffic between neighboring towns. By the current year 20,000 kilometres have been constructed, and bid fair to grow still faster in the immediate future. And London is thinking of experimenting!!!"

After describing the work on the Baltimore tunnel, the Hoboken Shore road, the manufacturers' line at New Haven, the Berlin-Hartford line and the Metropolitan West Side Elevated in Chicago, with a discussion of operation and costs, the report concludes as follows: "No more can the electric locomotive be looked upon as experimental. Daily work over many months has demonstrated its superior tractive power over steam, and its reduced weight for equal power. Improvement, it is true, is still possible, but the electrical locomotive no longer requires inventing. It is there and has come to stay."

*See The Electrical World, June 4, 1898, page 693.


Amperes
Voltage
Voltage up, 4000 lbs.
Voltage down, 4000 lbs.
Amperes up, 5012 lbs., — 153 ft. per min.
Amperes up, 4000 lbs., — 152 ft. per min.
Amperes down, operator only,—153 ft. per min.
Amperes down, 1008 lbs.,—155 ft. per min.
Amperes up, 1008 lbs., — 157 ft. per min.
Amperes up, operator only,—153 ft. per min.
Amperes down, 4000 lbs.,—160 ft. per min.
Amperes down, 5012 lbs.,—160 ft. per min.
Seconds.

SPRAGUE ELECTRIC ELEVATOR TYPE X 38, RATED 4000 LBS., 150 FT. PER MINUTE.

Record of Elevator Tests.

Alternating-Current Machinery.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

CHAPTER XXVI.

REGULATION AND OUTPUT OF SINGLE-PHASE ALTERNATORS.

The armature reaction in an alternator has a similar effect upon the apparent drop of pressure in the armature under load, as the real reactance of the armature, so that under their combined influence the alternator behaves as though its real reactance were increased by armature reaction to an amount which may be called the apparent reactance, or synchronous reactance, and which may be

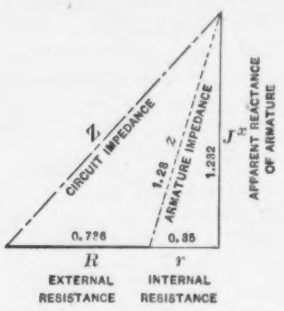


FIG. 149.—APPARENT IMPEDANCE OF CIRCUIT.

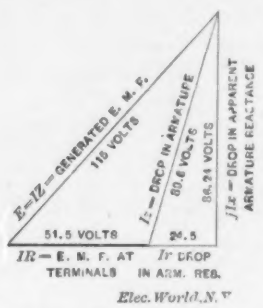


FIG. 150.—DROP OF PRESSURE IN CIRCUIT.

measured by observing the drop of pressure in the machine at constant excitation under various loads.

The apparent reactance of an alternator armature is quite large by comparison with its resistance, being, usually, between five times and twenty times its resistance, and commonly about ten times. The simplest way to determine the apparent reactance of an alternator is to operate it under a heavy load and observe the drop of pressure at terminals under constant excitation. Some alternators have so high an armature impedance that they can be operated on short-circuit for a short time without danger of burning out the armature coils, and without requiring any large amount of power. In such cases the apparent impedance of the armature is $Z = \frac{E}{I}$ ohms, where E is the e. m. f. of the armature, as measured under the same excitation at no load, and I is the short-circuit current strength. But in cases where the short-circuit current is too strong to observe, the terminal pressure e volts can be observed at a conveniently large current I amperes at non-inductive load. Then, knowing the internal resistance r ohms, the external resistance $R = \frac{e}{I}$ ohms, and the total apparent impedance of the circuit is (Fig. 149)

$(R + r) + j\,x$, where x is the apparent reactance of the armature. The total drop of pressure

$I\,(R + r) + j\,I\,x = E$, the generated e. m. f., as shown in Fig. 150, so that since $I\,x$, $I\,(R + r)$ and E form a right-angled triangle, we have

$$I\,x = \sqrt{E^2 - I^2\,(R + r)^2}$$

$$\text{and } x = \sqrt{\left(\frac{E}{I}\right)^2 - (R + r)^2}.$$

For example, if we consider an alternator having an e. m. f. at no load of 115 volts, an internal resistance of 0.35 ohm, and a terminal pressure under 70 amperes non-inductive load of 51.5 volts, then the external resistance

$$R = \frac{51.5}{70} = 0.736 \text{ ohm, and the apparent reactance is } x = \sqrt{\left(\frac{115}{70}\right)^2 - (0.736 + 0.35)^2}$$

= 1232 ohms, so that the apparent impedance of the armature is

$$0.35 + j\,1.232 = 1.28\ \underline{/74^\circ\ 08'} \text{ ohms.}$$

The drop of pressure in a continuous-current armature of E volts e. m. f., and resistance R ohms, at a current strength of I amperes, is $I\,R$ volts, and the terminal e. m. f. will be $e = E - I\,R$ volts.

The drop of pressure in an alternating-current armature of E volts e. m. f. and Z ohms apparent impedance, at a current strength of I amperes, is $I\,Z$ volts, and the terminal e. m. f. will be $e = E - I\,Z$ volts. The latter equation is, however, a vector equation, and must be interpreted geometrically. It will, therefore, be seen that the value of e depends not only upon the numerical values of E, I and Z, but also upon their phase angles. Thus, taking the generated e. m. f. as 115 volts of standard phase, and assuming that $Z = 1.28/74^\circ\ 08'$, then, for a given current strength $I = 27.8$ amperes, the drop will depend upon the angle of I. If this angle be O°, or in phase with the generated e. m. f.,

$I\,Z = 27.8\ \underline{/O^\circ} \times 1.28\ \underline{/74^\circ\ 08'} = 35.6\ \underline{/74^\circ\ 08'}$ (Fig. 151), and the terminal e. m. f. $= e_0 = E - I\,Z = 115 - 35.6/74^\circ\ 08' = 111$ volts (Fig. 154), representing a terminal drop of 4 volts. If I has a lag of 30° behind the generated e. m. f. then

$$Z = 27.8^\circ/\overline{30^\circ} \times 1.28/74^\circ\ 08' = 35.6\ \underline{/44^\circ\ 08'}$$

Fig. 152. The terminal e. m. f. $= E - 35.6/44^\circ\ 08' = e_{30}$. = 93 volts, Fig. 154 representing a terminal drop of 22 volts. With I lagging 60°, the drop is $35.6\ \underline{/14^\circ\ 08'}$ (Fig. (153) and the terminal e. m. f. e_{60} (Fig. 154) = 81.5 volts, representing a terminal drop of 33.5 volts.

On the other hand, if by the action of condensers or equivalent apparatus in the circuit, the current I should lead the generated e. m. f. by, say, 30° or $I = 27.8/30^\circ$, the drop $I\,Z = 35.6/104^\circ\ 08'$ and the terminal e. m. f. becomes e'_{30}, Fig. 154, =128.5 volts, in which case the terminal pressure is greater than the generated pressure by 13.5 volts, or there is a negative drop in the armature of this amount. Again, if the current leads the generated pressure by 60°, the drop is $I\,Z = 35.6/134^\circ\ 08'$, and the terminal e. m. f. is 142.5 volts e'_{60}, Fig. 154, or is 27.5 volts greater than the generated e. m. f.

These conditions show how much the drop of pressure at armature terminals, and therefore the automatic regulation of the alternating-current generator, depends upon the nature of its load. If it has an inductive load, the drop of pressure will be comparatively great, and the automatic regulation comparatively bad, while if it has a condenser load, the pressure at terminals may rise instead of fall with the load.

By taking successive values of external resistance from $R = \infty$ to $R = O$; i. e., increasing the non-inductive load from open circuit to short-circuit for the alternator considered in the preceding sections, with a generated e. m. f. of 115 volts and an armature impedance of $128/74^\circ$ ohms, we obtain the heavy middle curve plotted in Fig. 155. This agrees, with all reasonable precision, with the curve plotted in Fig. 1, p. 278, of THE ELECTRICAL WORLD for March 20, 1897. If z be the apparent internal impedance ($0.35 + j$ 1.232) and Z the external impedance ($R + j\,O$), the current strength in the circuit is $I = \frac{E}{Z + z}$ amperes, and the pressure at terminals is $E - I\,z$, or $I\,Z$ volts.

If the external impedance is inductive with a power factor of 0.8 or 80 per cent., corresponding to an angle of $/\ 36^\circ\ 47'$, so that the current in the external circuit apparently lags behind the terminal pressure by this angle, the reactance in the circuit at any given load is increased, and the pressure at terminals for constant excitation follows the lower dotted curve in Fig. 155. This is nearly a straight line between 115 volts and zero, representing an apparent drop of pressure in the armature nearly proportional to the

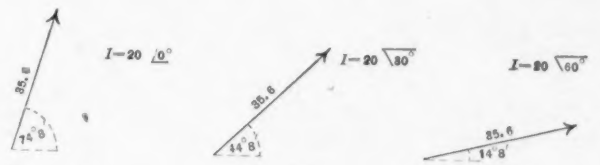


FIG. 151. FIG. 152. FIG. 153.

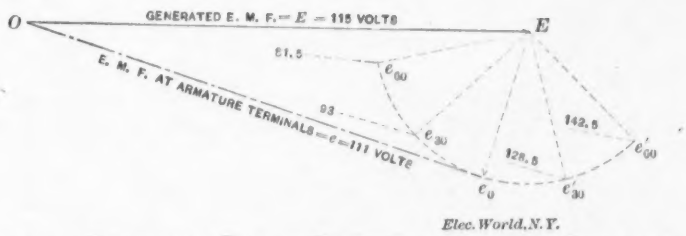


FIG. 154.—DIAGRAM OF DROP OF PRESSURE IN ARMATURE IMPEDANCE.

load current. If, on the other hand, the load contains condensers and has a leading power factor of 0.8, the reactance in the circuit will now be reduced, since the reactance of the condenser load is negative, or neutralizes to a greater or less extent the inductive reactance of the armature. The terminal pressure will now be represented by the upper broken line in Fig. 155, and the pressure at terminals is greater than the generated e. m. f. as far as 63 amperes of load current. If we take 25 amperes, as representing the full load of this machine, the terminal pressure at non-inductive load will be 102, with inductive load of 80 per cent. power factor, 88 volts, and with condenser load of 80 per cent. power factor, 122.5 volts, respectively. A condenser load in alternating-current practice is unusual, but the condition of inductive load of 0.8 power factor may readily happen, and it is evident that such an inductive load may readily double the apparent drop of pressure at armature terminals, which would be produced by a non-inductive load, requiring an increased compounding, if the alternator is compound wound.

If the resistance of an alternator armature is such that the non-inductive full load drop of pressure in this resistance is 2 per cent. of the generated e. m. f., and the apparent reactance of the armature is ten times the resistance, the drop of pressure in this reactance is 20 per cent. of the generated e. m. f. Since these are in quadrature, we have percentage of generated e. m. f. expended in resistance

$$= \sqrt{100^2 - 20^2} = 98$$ per cent. approximately, and of this 2 per cent. is in the armature, leaving 96 per cent. at armature terminals. Consequently, such a machine on non-inductive load has a terminal drop of twice its resistance drop, or

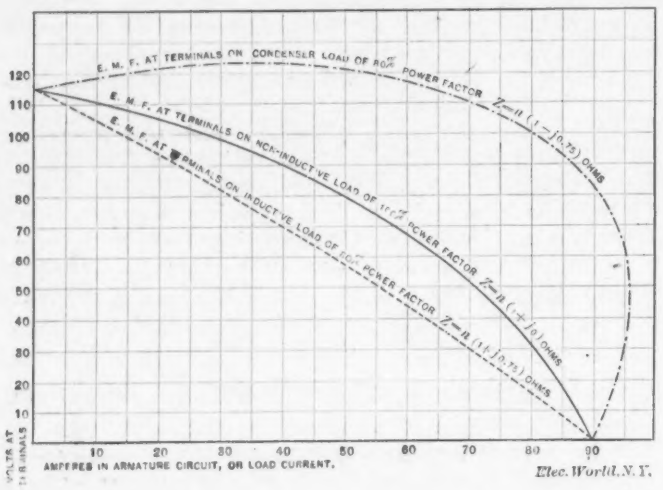

E. M. F. AT TERMINALS ON CONDENSER LOAD OF 80% POWER FACTOR Z=11 (1-j0.75) OHMS
E. M. F. AT TERMINALS ON NON-INDUCTIVE LOAD OF 100% POWER FACTOR Z=11 (1+j0) OHMS
E. M. F. AT TERMINALS ON INDUCTIVE LOAD OF 80% POWER FACTOR Z=11 (1+j0.75) OHMS
VOLTS AT TERMINALS
120
110
100
90
80
70
60
50
40
30
20
10
10 20 30 40 50 60 70 80 90
AMPERES IN ARMATURE CIRCUIT, OR LOAD CURRENT.
Elec. World, N. Y.

Fig. 155.—Diagram of E. M. F. at Armature Terminals Under Varying Load Currents and Constant Excitation.

its apparent drop of pressure is as much due to reactance as to resistance. This is a common condition in practice.

The power delivered by an alternator at its terminals is $P = e\,I\,k$ watts, where e is the terminal e. m. f. in volts, I the current strength in amperes and k the power factor of the load, or the cosine of the supposed phase angle between e and I. In the case of a non-inductive load $k = 1.0$ or 100 per cent., and $P = e\,I$ watts, as in the case of a continuous-current generator. With constant excitation, the power in a non-inductive external circuit is a maximum when the external resistance is equal to the internal apparent impedance, or when $R = Z$.

In the case of the alternator, in connection with Fig. 155, $Z = 1.28$ ohms $= (0.25 + j\,1.232)$, and the external resistance for maximum power is, therefore, 1.28 ohms. The impedance of the circuit at this load would, therefore, be

$$\begin{aligned} Z &= (1.28 + 0.35 + j\,1.232) \\ &= 1.63 + j\,1.232 \\ &\sqrt{(1.63)^2 + (1.232)^2} \\ &2.043 \text{ ohms } \angle 36^\circ\,52' \end{aligned}$$

The current in the circuit would be

$$I = \frac{E}{Z} = \frac{115}{2.043\ \angle 36^\circ\,52'} = 56.3\ \angle -36^\circ\,52'$$

amperes, corresponding to $e = 72$ volts. The total power in the circuit is $E\,I \cos(36^\circ\,52') = 115 \times 56.3 \times 0.8 = 5180$ watts. The power in the external circuit is $e\,I$, since the power factor is 100 per cent. $= 72 \times 56.3 = 4054$ watts, and either an increase or decrease of the load current at 56.3 amperes will result in a diminution in the external power. In the case of continuous-current generators, it is known that theoretically the output is a maximum when the external resistance is equal to the internal resistance, or with a drop of 50 per cent. in the armature. In practice, however, except in the very smallest machines, such an output is never reached, owing not only to the low electric efficiency of 50 per cent. so obtained, but also to the large amount of power which would be expended in the armature and which would speedily destroy it. In the case of the alternating-current generator the corresponding rule is, as we have seen, that the output is a maximum on non-inductive load when the external resistance is equal to the internal impedance, and, although in practice this output is not usually reached, yet owing to the reactance of such generators this condition is much more nearly approached than in the case of a continuous-current machine.

Electrolysis of Cast-Iron Water Pipes at Dayton, Ohio.*

BY HAROLD P. BROWN.

The injury of water pipes by electrolysis is at present so well understood that my only excuse for again calling your attention to the subject is found in the peculiar and unusual conditions disclosed at Dayton, Ohio, in an examination made last July.

All of us know that electrolysis may be expected to injure lead and wrought iron pipes on the lines of electric roads within a radius of half a mile from the power house, but we have believed that cast iron mains were safe.

Our faith has been rudely shaken by the condition of these pipes at Dayton. They appeared to be entirely uninjured, and the black paint seemed to be unaffected. But on scraping the pipe with a knife the metal was found so soft that grooves could be cut into it. Therefore sections were removed for mechanical and chemical tests, and the results fully justify your most careful attention, since your own pipes may perhaps be in a similar condition.

The electrical tests showed that the pipes in the business portion of the city, 1½ to 2 miles from the power houses, were positive to the rails and therefore subject to electric corrosion. The highest readings in this part of the city were 4½ volts near Fifth Street Bridge and near Washington Street Bridge. Near the power house on the west side of the river the pipes were 9 volts positive to the rails, and the danger district extended about three-fourths of a mile to the west. In the southern part of the city the highest positive reading was 2 volts in front of the Oakwood Avenue power house.

It was at once evident that the danger district was extremely large in which lead and wrought iron pipes would be injured. This was verified by the records of the water board, which showed a large number of service pipe renewals. These renewals are very expensive in Dayton, because the foundations of pavements are unusually heavy and unusually well constructed.

Cast iron pipe is usually little affected by electrolysis, since the coating of adherent moulding sand and tar paint protects it. In the ordinary soil an iron pipe submitted to electrolytic corrosion is covered with a layer of iron oxide, which is a poor conductor of electricity, so that with a given pressure the deeper is the layer of rust and the slower the rate of corrosion.

But, to my surprise, the soil surrounding pipes in Dayton gives an entirely different reaction when a current passes through it. The tar seems to be no protection whatever, and the surface of the pipe in the danger district is changed into a soft black material resembling graphite and easily cut with a knife. This material is such an excellent conductor that instead of checking it tends to increase the action by reducing the resistance of the path through which the current must flow in order to reach the rail. Moreover, the stones and pebbles near the pipes are actually electro-plated with the metal of the pipe, whether iron or lead. This condition I had never before seen, and as far as I know it has not been previously reported.

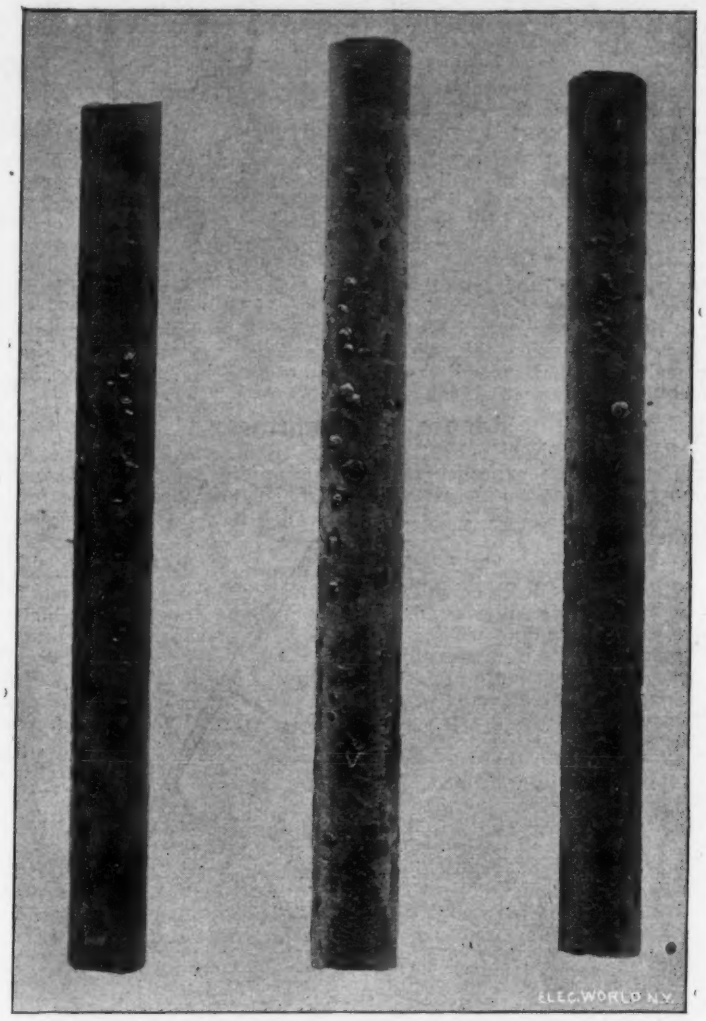
Since my Dayton report was published I have received a letter from Mr. Dabney H. Maury, Jr., superintendent of the Peoria Water Company, Peoria, Ill,, in which he states that he has encountered the same phenomena.

In order to electrically deposit a layer of metal two things are

*Abstract of paper presented before the American Society of Municipal Improvements, Washington, October, 1898.

necessary: first, a liquid which will dissolve the metal; and second, an electrical current exceeding 0.01 of a volt in pressure, flowing away from the metal through the liquid. The fact that the pebbles are electro-plated showed that both these conditions exist, but in order to prove conclusively that the soil itself did not injure the pipes, a pipe surrounded by the same soil was uncovered in another portion of the city, where there was absolutely no trace of an electrical current. This pipe was on Logan Street, near the canal; the records showed that it was put down in 1874, while the pipe taken out at the west end of Fifth Street Bridge had been in use ten years, and exposed to electrolysis for four years. If the damage was caused by the soil itself, this pipe would, of course, have been in a worse condition than the Fifth Street pipe. But the Logan Street pipe was apparently as good as new.

The chemical analysis of the soil showed that the solvent was produced electrically from carbonates of sodium and chloride of sodium in the soil. Neither of these by itself in the small proportion shown by the analysis would injure a cast iron pipe covered



CAST IRON WATER PIPES REMOVED FROM THE STREETS OF DAYTON, OHIO.

with tar, though, as is well known, a strong solution of chloride of sodium or common salt will rust wrought iron.

But the presence of even 0.01 per cent. reduces the electrical resistance to the iron and the passage of the current decomposes these salts and forms muriatic or hydrochloric acid, which dissolves the metals. Having thus determined the cause of the trouble, it remained to fix its extent. Fifteen excavations were made in different parts of the city to determine how much electrical pressure is required to seriously injure the cast iron.

A pressure of 3 volts and less is found to cause a graphite coating not exceeding one thirty-second of an inch in depth; the iron seems to be uninjured. From 3 to 4½ volts the thickness of the layer is increased in a ratio depending upon length of time during which the pipe has sustained this pressure. With a knife or file soft spots from one-sixteenth of an inch to one-quarter of an inch deep can be found in a pipe. With higher electrical pressures the extent of the injury is even greater. In all cases the damage is directly proportional to the pressure and to the length of time during which the current has been flowing, while it is inversely proportional to the distance between the rails and pipes.

In my opinion all mains and service pipes in Dayton are seriously injured where submitted to 3 volts' pressure or more for two or more years when within 4 feet of the rails. This would mean less than 1 mile of mains, but with lead or wrought iron service pipes the pressure limit should be as low as 1 volt. Mr. Chas. E. Rowe, secretary of the waterworks, however, feels that 17,513 feet of mains should be replaced at a cost of $77,000.

To determine what percentage of mechanical injury had been sustained by the pipes it was intended to compare the hydrostatic pressures required to rupture the Logan Street and the Fifth Street pipes, but defects in the apparatus employed prevented a fair test. The Fifth Street pipe, at 150 pounds pressure, leaked through the corroded spots, while the other pipe was able to stand 300 pounds pressure. Test bars were cut from the best portions of both pipes and broken on a Riehle testing machine. The average transverse strength of the Logan Street pipe was 1800 pounds per square inch as against 1085 pounds to the other. The tensile strengths were respectively 16,000 and 11,425 pounds, and the deflections were 0.25 and 0.20 of an inch. Four years of electrolysis had robbed the Fifth Street pipe of about 30 per cent. of its transverse strength and about 45 per cent. of its tensile strength, and had caused it to leak at 150 pounds pressure.

I feel confident that if the railroads would unite in the expenditure of five to seven thousand dollars for the proper electrical apparatus and connections, all the water pipes in Dayton could be maintained negative to the rails. Then the pipes would harden. Moreover, any further electrolysis that might occur would be in the oppositie direction, and would therefore add a layer of metal to the pipes instead of injuring them. I will not here enter into discussion of the electrical methods required in Dayton to obtain this result, but it is evident that no plan heretofore suggested for electrolysis prevention will effect a cure there,owing to the unusual conductivity of the soil and the peculiar division of the city.

The railway manager is as much interested in stopping the trouble as you are ; every pound of metal taken from your pipes means to him a heavy loss of power, increased investment for engines, boilers, dynamos and conductors. And if it is finally established by legal decisions that his current has injured your property he will have to settle the bill. The best course for all concerned, it seems to me, is to take mutual action while that bill is small, and not wait until a bursting main during a fire spreads the loss over the entire community. I would like to offer the following practical suggestions:

1. It will not be a mistake to follow Dayton's example and obtain complete and accurate information concerning the electrical, chemical and mechanical condition of your pipes, especially in the vicinity of the power houses. The trouble may be confined entirely to the lead in the service pipes, and in the calking of joints on your mains; but even here serious damage may result if the matter is neglected for years.

2. Do not put down any more lead or wrought iron service pipes, as these are the first victims of electrolysis and their replacement means ruin to pavements. Use instead wooden pipe, banded with a close spiral of hoop iron and covered heavily with asphaltum. This will stand the heaviest pressure in use, and is not affected by electrolysis, since the hoop iron is low in conductivity and is not electrically connected at the joints. Its cost is said to be reasonable, and it has a successful record of many years' service.

3. Use the same kind of pipe for new mains in any district in which a railway power house is likely to be erected and heavily paint the lead calking of cast iron mains, using asphalt or petroleum wax.

4. In the danger district along the lines of electric roads and on intersecting streets put into your water and gas mains two or more consecutive lengths of these wooden pipes so as to break the electrical continuity of the mains, and thus make their resistance greater than that of the rails. Fill in the space around them with broken stone and connect with drain if possible.

5. Midway between the wooden sections on each main attach insulated pilot wires, leading to a central office. Connect similar wires to the rails nearest the pipe wires and make daily electrical tests at times of heavy load. If any section shows positive to the rails cut it at once into smaller sections and call upon the railway to rebond its line upon that street. This, with the proper electrical management of the railway feeder wires and apparatus, will effectively protect your mains.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering.

Dynamos, Motors and Transformers.

ROTARY CONVERTERS. S. P. Thompson. Lond. "Elec. Eng.," Nov. 18.—The continuation of his paper (see "Digest" last week); it is also being reprinted in the "Elec." and "Elec. Rev." A number of interesting results, which these diagrams show, are pointed out; when the alternating current is reversing, for instance, the armature is operating simply as a motor and is being accelerated; when the alternating current is at a maximum the armature is operating wholly as a generator and the acceleration is negative; the armature is then adding 100 amperes to the 100 coming from the primary mains. The coils, which are close to the slip-ring, are moreover heated much more than those which lie midway between the connectors, the distribution of the heating being quite different from that when the armature is used for either a motor or a dynamo; this unequally distributed heating effect is in total also somewhat greater in the former than in the two latter, but it is less than the total heating effect if used as a single-phase generator or motor, the ratios being 1 to 1.366 to 2 in the three cases. Some curves show this unequal heating effect for the case of a single-phase converter. He then considers what differences will be made if the magnetic distribution does not follow a sine law; if the poles are narrowed so as to concentrate the fields, even though the continuous voltage remains unchanged, the alternating voltage will be increased and the curve will be more peaked than a sine curve; if used to convert continuous into alternating currents the effect will be to raise the effective alternating voltage and to lower the relative alternating current. If used for the reverse process the converse result takes place. If the machine is used to convert single-phase into continuous currents the form of the curve and the distribution of the flux are of greater importance and the apparatus is less satisfactory than the two-phase or three-phase converter; it has greater variations of armature reactions and greater and more unequal heating, and requires more accurate setting of the brushes; it is not self-starting from the alternate-current side; notwithstanding these disadvantages, such machines are in satisfactory use. He then considers the two-phase converter, showing again a succession of diagrams and the currents flowing at each instant. The inequality of the heating is much less in this case. The armature reactions are more nearly balanced, and there is much less tendency to impart a periodic fluctuation to the continuous current; such machines are self-starting and give little trouble from sparking. Another series of diagrams shows the flow of currents for a three-phase converter.

ROTARY CONVERTERS.—Lond. "Elec. Rev.," Nov. 18.—A short editorial article calling attention to the low efficiency due to multiplicity of conversions. Both at Niagara and for the Central London Railway it is thought doubtful whether the use of rotary converters is of any advantage over direct generating of continuous currents. It is thought that converting apparatus are necessary evils, to be adopted only after all attempts at a direct method have failed.

THEORY OF THE ROTARY TRANSFORMER. Kapp. Lond. "Elec.," Nov. 18.—The beginning of a translation in abstract from the German of the article noticed in the "Digest" Oct. 15 and 22.

BRAKING IN SINGLE-PHASE INDUCTION MOTORS. Eichberg. "Zeit. fuer Elek.," Nov. 13.—In such motors there are two fundamentally different methods of braking, first by the insertion of a certain resistance in the armature, and second, by bringing the motor into the condition of over-synchronism. He discusses both these methods, admitting that the results are more of theoretical than practical interest. He shows that it is possible to brake a running motor of this kind by connecting a resistance of a certain particular value in the armature circuit; for other values the effect on the torque may be positive or negative. He suggests that with such a resistance the motor may have a speed of equilibrium quite different from that of synchronism. The second method, as also both combined, are also discussed, and it is shown that with the combined method it is possible to brake the motor until it comes to rest.

REVOLVING FIELD MOTORS. Hanappe. "L'Eclairage Elec.," Nov. 12.—The continuation of his long article. He discusses the operation of non-synchronous motors with revolving fields for polyphase currents. It is mathematical in character and includes a number of diagrams.

ENERGY IN SHORT-CIRCUITED ARMATURES. Roessler. "Elek. Zeit.," Nov. 17.—The conclusion of his long article (see "Digest," last week). He discusses in a similar way the second case, and concludes with a short summary of the formulas with which he claims that the behavior of a short-circuited armature in such alternating-current motors can be calculated in a simple way.

ELECTRIC GENERATORS. Parshall and Hobart. Lond. "Engineering," Nov. 18.—In this continuation of their long serial they illustrate the method of determining the inductance by working out several cases relating to drum windings.

CALCULATING ARMATURES FOR A CONTINUOUS-CURRENT MACHINE. Grassi. "L'Eclairage Elec.," Nov. 12.—A reprint of a short article from an Italian journal in which he shows how to calculate the relation between the diameter and length of an armature, based on the loss by the Joule effect—that is, by the heating due to the resistance. He applies the formula in certain examples.

MAGNETIC FIELDS OF BIPOLAR DYNAMOS. Hess. "Elek. Zeit.," Nov. 17.—Illustrations, accompanied by descriptions, of iron-filing picture, showing the distribution of the lines of force in a ring and drum armature alone, in the field alone, and in both combined; the illustrations were made with iron filings on sensitive paper and by means of open-wound coils, resembling those of an armature, but with no iron in the core, thus showing the field in the interior; they were made for the purpose of instruction, and differ somewhat from those in S. P. Thompson's book. The differences when used as a motor and dynamo are also shown. A small working model is described and illustrated in which the armature consists of a single flat ring around which an open spiral is wound and connected to a commutator as usual, the whole revolving horizontally between two poles; with the aid of iron filings this enables the field to be shown while in action.

PARALLELING ALTERNATORS.—"Elek. Zeit.," Nov. 17.—A communication from Schueler and another from Benischke, both stating that the method recently described by Burch (see ELEC. WORLD, Oct. 8) is not new. The latter, moreover, states that he has used it with 2000-hp, three-phase machines, but found no advantage in it; he describes this particular case. The remnant magnetism is not sufficient, as Burch claims, to bring the machines into step; he had to excite them a little. He considers it very hazardous to connect an excited machine in parallel with a loaded one: even though there would be no short circuit, as with the continuous-current machine the current will be from 3 to 10 times of the normal, and the fuses will therefore blow, or if no fuses exist, the machine is in danger of being burnt out.

Lights and Lighting.

DERY INCANDESCENT LAMP.—"Elek. Anz.," Nov. 17.—A note stating that experiments with this modified form of Nernst lamp have given good results; the lamp is now being made for street lighting purposes, and it is stated that it will soon be on the market.

Power.

ELECTRIC CRANES AT SOUTHAMPTON.—Lond. "Elec.," Nov. 18.—A brief, illustrated description of the new cranes which have just been completed for the work at the harbor. They differ in many respects from the older ones. One of the new departures is an arrangement for automatically ringing a bell in the cabin when the load is too great; one of the bearings rests on springs, and when the pressure is too great a contact for a bell is made. Another feature is the combined crane; there was a necessity for a 12-ton crane as a standby, but instead of making this a separate crane a 12-ton hoisting gear was combined with a 3-ton crane by means of an arrangement of gears; the change from one to the other can be made in about one minute. The 3-ton cranes will lift 30 cwt. at 200 feet per minute, or 3 tons at a proportionately lower speed; the radius of the swinging cranes is 30 feet, and the normal slewing speed 400 feet per minute. There are two separate motors, one for the hoisting and one for the slewing motions, the former a 50-hp and the latter a 10-hp; the lifting motors of the 3-ton cranes are not reversible and have copper brushes, but those for the 12-ton cranes are reversible and have carbon brushes like the slewing motors; the voltage is 200, and the consumption of power from 3.5 to 5 kw-hours per hour, the cost being 6 cents per unit; but even at this comparatively high price the electric cranes are superior for handling cargoes cheaply and quickly, as much more work can be got out of them; they are less likely to get out of commission through breakdowns, and are much more quickly repaired, the cost of repairs being trifling; there is a great saving in standing charges, since the generating plant is also used for lighting. Men unskilled in electrical machinery can handle the cranes very well.

POWER TRANSMISSION FOR MINING. Esson. Lond. "Elec. Eng.," Nov. 18.—An abstract of a paper read before the Institution of Civil Engineers. He points out the advantages due to the fact that the crushing mills can be placed at the mine, if electrical power transmission is used, thus avoiding the serious expense of transporting the ore to the seat of the water power. The question of whether power transmission should be adopted is briefly discussed. The greater part of the paper refers to a description of the plant of the Sheba Gold Mining Company, in which power is transmitted electrically to the crushing mills 5 miles distant, reducing the cost of milling from about $1.50 per ton to about 40 cents per ton, an aerial ropeway transport having formerly been used; the generating plant consists of three alternating-current dynamos running at 3300 volts.

POWER GAS.—"L'Eclairage Elec.," Nov. 12, and "L'Ind. Elec.," Nov. 10.—A long, illustrated description of the Riché gas,

which is intermediate between what is known as power gas and lighting gas, and is obtained from the distillation of wood; it can be used as well for power as for heating. The composition and calorific power of the principal commercial gases is given; for city gas the mean value is about 5250 calories per cubic metre; that of Dawson gas is 1346 and that of Riché gas is 3029; the article is a reprint, in part, of a pamphlet.

SHOREDITCH.—Lond. "Elec. Rev." and "Elec. Eng.," Nov. 18.—A reprint of the official report of the first year's working results of this dust-destructor plant; it is followed by the discussion of it by the committee. The report appears to show a net profit of about $13,000. The same journals contain also a communication from Baker, giving his interpretation of the published results.

ELECTRIC ELEVATORS.—Lond. "Elec. Rev.," Nov. 18.—Brief, illustrated descriptions of some of the mechanisms used on the Siemens and Halske elevators, one for rapid and one for slow speeds; worm gearing is used.

SOCIAL INFLUENCE OF ELECTRIC POWER.—Lond. "Elec.," Nov. 18.—A long editorial referring to electric traction and the use of electric motors for industrial purposes.

ELECTRIC MOTORS IN SHOP AND MINE. Barber. "Eng. and Min. Jour.," Nov. 26.—An abstract of a paper read before the Civil Engineers' Club of Cleveland. The advantages of the electric motor are pointed out; the relative loss of power in the two forms of transmission was briefly discussed. The first cost of the electrical installation is said to be greater than that of belt and shaft transmission, but the cost of maintenance is less. The opinion was expressed that an electric percussion drill could be made, but that none has yet been produced that fulfills the requirements, while the pneumatic percussion drills are highly perfected.

ELECTRIC POWER ON SHIPS.—"El'ty," Nov. 30.—Brief quotations from reports to the Navy Department by officers of the Brooklyn concerning the operation of the machinery on that steamer, which was driven electrically. The Brooklyn is said to be the most thoroughly electrically equipped vessel in the United States Navy. The reports refer to the results of experience during the recent war; the operation of the electrically driven machinery is reported to have been very satisfactory.

ELECTRICALLY OPERATED PUMPS. Bunnell. "Eng. Mag.," Dec.—An illustrated article pointing out the conditions under which electricity is the most desirable motive power for pumps and discussing the advantages of some of the types of pumps specially designed to be electrically driven; the latter are illustrated.

POWER FROM COKE OVENS.—"Eng. and Min. Jour.," Nov. 26.—A note stating that a large electric power plant has been proposed, to be run by gas engines from the surplus gases forming the bi-product in coke ovens at Dunbar, Pa.

GRENADA.—"West. Elec.," Nov. 26.—A translation of the article noticed in the "Digest" Oct. 22.

Traction.

CANAL HAULAGE. Allen. Lond. "Elec.," Nov. 18.—A brief reply to the recent communication of Galliot (see "Digest," Nov. 26). He claims that his own remarks were perfectly correct. He states that one horse can haul 120 tons at a speed of 2.25 miles per hour for four hours without difficulty; the pull is about 2 pounds per ton; the pull is increased in proportion to the square of the speed; a pull of 300 pounds at a speed of 2.5 miles per hour is equivalent to 2 horse-power on the tow-rope, but the motor must exert twice this pull when starting. He claims that the prevalent impression that the average horse can perform only two-thirds or three-fourths of a mechanical horse-power is wrong, as a horse can work at the rate of 1.5 mechanical horse-power for four hours a day or 1 horse-power for eight hours a day without injury, and can easily exert a pull of 600 pounds for a short distance. He questions how Galliot's tricycles pass one another, intimating that it involves considerable delay. The pull on the tow-rope equal to 6 horse-power at a running speed of 2 miles per hour is 1125 pounds, which is much greater while getting up speed, so that the weight of the tricycles and the wear on the tow-path must be very great.

HEILMANN LOCOMOTIVE.—"L'Ind. Elec.," Nov. 10.—A short article referring to some recently published data, which, however, is only very brief. It is claimed in the original that the results of these experiments have been satisfactory, and that the trials are to be continued on the line from Rouen to Havre, then from Paris to Cherbourg and finally to Brest.

"L'Elec.," Nov. 12, contains a few notes referring to recent trials, which are said to have been satisfactory; no information of importance is given.

TRAFFIC ON LONDON STREETS. Barry. Lond. "Engineering," Nov. 18.—An abstract of his inaugural address at the Society of Arts. He refers to the more or less distant future; he does not seem to have much faith in the deep-tunnel railways, as cheap fares on surface lines would command most of the traffic; he therefore suggests widening the streets and providing bridges at crossings like the present Holborn viaduct. He does not seem to mention the use of electricity for power.

TRACTION BOOSTER.—Lond. "Elec. Eng.," Nov. 18.—Answers to the question whether it is better to use motor generators or accumulators as boosters at the end of traction feeders. One of the answers, after discussing the question, concludes that in capital outlay, efficiency and maintenance the advantage is in favor of the motor generator, but for smooth working, reliability and a ready standby, adopt accumulators.

LYONS.—"L'Elec.," Nov. 19.—An illustrated description of the electric railways in that city, where the change from horse to electric traction has recently been completed for the whole city; the installation was made by the Thomson-Houston Company.

LIVERPOOL.—Lond. "Elec." and "Elec. Rev.," Nov. 18.—A long, well-illustrated description of the electric trolley line.

GLASGOW.—Lond. "Elec.," Nov. 18.—A well-illustrated description of the electric trolley line in Glasgow.

CHICAGO.—Lond. "Elec.," Nov. 18.—A brief, illustrated description of the West Side Elevated Railroad.

TRAMWAY UNION.—"L'Elec.," Nov. 12.—A brief account of the meeting of the International Tramway Union at Geneva last August; the principal matters which interest electricians are referred to.

AUTOMOBILE ACCESSORIES.—"L'Ind. Elec.," Nov. 10.—A short notice stating that a prize of $80 is offered for a sort of box or enclosed switchboard of a universal nature for electric automobiles and containing such things as a voltmeter, an energy meter, a rheostat, a pair of conductors, with universal terminals for connecting to the battery, etc.

AUTOMOBILE DELIVERY WAGONS.—"L'Energie Elec.," Nov. 1.—A long, illustrated article on the recent competitive exhibition near Paris, in which sixteen such vehicles took part, three of which were electrical. Brief, illustrated descriptions are given.

HEILMANN LOCOMOTIVE.—"Eng. News," Nov. 24; abstracted in the "Elec. Eng.," Dec. 1.—A short article giving a description of both the old and the new locomotive, with an illustration of the new one; the data was received from the Heilmann works, and refers to the construction as distinguished from the operation. Although it can develop considerable power, it does not seem to be capable of hauling very heavy trains or of attaining any exceptional speed. One advantage claimed is an economy in coal consumption, but the information gives no particulars of any work done in hauling heavy trains. A comparison is made between the figures of the first Heilmann locomotive with those of some new steam locomotives. The subject is also commented on editorially; it is stated that a fact which is often overlooked is that a steam locomotive generates power at a much lower cost than any stationary steam plant. The argument often made that the electric locomotive is a future certainty, is also discussed, and it is shown that the electric car or locomotive operates under entirely different conditions from those on steam railways, and that it is used where the steam locomotive could not operate economically; all electric railways thus far built have been for purely local traffic, the Heilmann engine being the only attempt to use electricity for ordinary railway service; the published results give no reason to expect a more extended use of that machine. In conclusion it is stated that there is no reason to expect the application of the electric locomotive to ordinary railway service.

SURFACE CONTACT SYSTEM. Johnson. "Elec. Eng.," Dec. 1.—The continuation of the reprint of his paper noticed last week. A reprint is also begun in "El'ty" and "Elec. Rev.," Nov. 30.

BUDAPEST.—"Eng. News," Dec. 1.—A full-page illustration, with a brief description, of the compound engine at the power-house of the Budapest electric railway.

AUTOMOBILE. Child. "Sc. Am. Sup.," Nov. 26.—A long, illustrated description, including drawings, of an electric tricycle, which is so designed that it can be constructed by an amateur with the resources of a small machine shop. It is intended for one person, for a maximum speed of 12 miles an hour and a capacity of a 20-miles' run with one charge of the battery. The construction of all the parts is described and illustrated. The batteries are of the lead-zinc-cadmium type.

Installations, Systems and Appliances.

BRIGHTON BREAKDOWN.—Lond. "Elec. Rev.," Nov. 18.—An anonymous communication in which it is suggested that a thoroughly good short circuit on one dynamo would necessarily interfere with the excitation of all others in parallel with it; if the machines had shunt excitation only their voltage would immediately fall to zero without waiting for a reduction in speed. This is followed by a communication from Tapper describing the occurrence, with an illustration; he was one of the engineers present at the time. All the dynamos were practically self-exciting, and no battery was in use. The sequence of events was as follows: A series of loud reports, accompanied by showers of sparks and melted copper, with a drop of about 50 per cent. in the voltage; the lights remained steady for five or six seconds, and then gradually died out during forty to sixty seconds. The cut-out of the faulty machine was seen to fall and was badly burned; none of the others showed any signs of burning. The whole shutdown lasted twenty to twenty-five minutes. A band was found loose on the armature of the damaged machine, and a large hole was burnt into the copper bars immediately under it.

GRUYERE.—"L'Eclairage Elec.," Nov. 12.—A brief, illustrated description of a small plant in this part of Switzerland; it is said to be one of the first alternating-current stations in that country, and was installed in 1893.

ZURICH.—"Elek. Zeit.," Nov. 17.—Long extracts from the official report of the operation of this station for last year.

CHICAGO.—"West. Elec.," Nov. 26.—A brief, illustrated de-

scription of a plant which has just been installed for running 866 arc lamps for street lighting.

PARIS. Bayly. "Elec. Rev.," Nov. 30.—A short description of the central station at Place Clichy. The method of charging the accumulators by means of a booster is described.

Wires, Wiring and Conduits.

NON-INTERCHANGEABLE FUSES. Erlacher. "Elek. Anz.," Nov. 13.—A brief, illustrated description of a modification of the fuses of the Rittershausen system, which was the one which received the prize from the German society; it has some faults, however, which are claimed to be overcome by the present modification. The object of the system is to make it practically impossible to insert a larger fuse in the block than the one for which it was intended. In the original form a larger fuse could be inserted if the fuse was simply bent a little. In the present modification the screw clamps are so made that the movement of the nut is limited; it would be possible to insert a smaller fuse, but not a larger one, as the thickness would be too great to clamp under the screw. An illustration is given, but it is not very clearly described.

FINDING A SHORT CIRCUIT. Dobbs. "Elec. Eng.," Dec. 1.—A note showing how a short circuit in a lamp socket may be readily found in long strings of incandescent lamps in multiple, such as are used for decorating purposes. An attempt was first made to blow out the short circuit with a large current, but this was not successful. The string of lamps was then connected in series with a circuit of about eight lights, and a compass was then moved along the main wire, to which the lamp sockets were attached; the needle gave a constant deflection until the short-circuited socket was reached when it suddenly swung to a different position. The method is believed to be applicable to many other cases.

LINE INSULATORS. Perrine. "Elec. Eng'ing.," Nov.—A long article which is of the nature of a short treatise on such insulators, describing the various forms and discussing their properties.

HISTORIC INSULATOR.—"Elec. Eng'ing.," Nov.—An illustration of what is thought to be probably the oldest specimen in existence of that type of insulator which is used in places where the permanent fastening of the wire is not desirable; it is the form used originally on the Washington-Baltimore line, and was obtained from one of the first lines built in Wisconsin, in 1848.

Electro-Physics and Magnetism.

HIGH-FREQUENCY CURRENTS AND DISCHARGES. Ebert. "Wied. Ann.," 65, p. 761; abstracted at considerable length in the "Elek. Zeit.," Nov. 10.—He discusses the use of high-frequency currents for studying discharges in gases. A gas cannot be compared directly with a conductor of the first class nor with one of the second class; the gas acts more like a combination of a conductor which conducts like one of the first class, or also like an electrolyte, and a "capacity-resistance" arising from a sort of dielectric action, which resembles a polarization resistance; the discharge tube might be compared to a condenser which has been pierced. In his researches he investigated this condenser action. In the first part of the paper he describes with the aid of illustrations the machines and the apparatus which were used; the former gives currents of a frequency of about 500 per second, which is sufficient for that purpose. He found that a discharge tube acts like a condenser toward the oscillations of the current. When the pressure of the gas in the tube was varied he found that at the high pressure at which the column of gas just breaks down, as also at very low pressures, the voltage at the electrodes is very high and the current small; at a certain intermediate value the voltage becomes a minimum and the current a maximum; with decreasing pressures there is first a diminution in the product of the volts and the amperes, up to a point of inflection, then an increase up to a maximum; at very low pressures, at which finally no discharge can take place, the energy diminishes to zero.

DEPENDENCY OF THE CAPACITY ON THE FREQUENCY. Hanauer. "Wied. Ann.," 65, p. 789; abstracted briefly in the "Elek. Zeit.," Nov. 10.—Descriptions of experiments to determine the dependence of the capacity of the condenser on the frequency of the alternating current. He experimented with glass, mica, hard rubber and paraffin paper; also with petroleum, benzine, a mixture of benzine and ethyl alcohol, and castor oil. His results are that with solid, as with the better conducting fluid dielectrics, there is an alteration in the capacity with the frequency of the alternating current. With solid dielectrics there is a simultaneous loss of energy, which increases with the duration of the oscillations, and is greater the greater the change of the capacity and the frequency.

CALCULATING THE ELECTROSTATIC CAPACITY OF LINES. Breisig. "Elek. Zeit.," Nov. 17.—A long article describing a method for calculating the electrostatic capacity of overhead lines, in which the action of the surface of the earth on the electric distribution is considered. He begins with the general case of a system of straight, parallel lines, which are also parallel to the earth's surface in the neighborhood of the earth. His solution is not mathematically correct, but is said to be sufficiently approximate for all practical purposes, the accuracy being greater than that with which the various dimensions, such as the diameter of the wire, the distance between them, etc., are given.

METALLIC DEPOSITS FROM THE DISSIPATION OF WIRES. Toepler. "Wied. Ann.," 65, p. 873; abstracted, with some illustrations, in the 'Elek. Zeit.," Nov. 10.—He describes experiments made with a wire held over a glass plate and dissipated by high-tension discharges; a mirror-like deposit is then produced by the dissipation of the wire by these discharges.

ELECTRO-DYNAMICS. Leray. "Cosmos," Nov. 12 and 19.—The beginning of a long article on the electro-dynamic laws of electric currents and their effect on the surrounding ether; it is of a theoretical nature.

CONTINUOUS CURRENTS IN THE ALTERNATING ARC. Eichberg and Kallir. "Elek. Zeit.," Nov. 17.—An illustrated abstract of the article noticed in the "Digest" Nov. 5.

ACTION OF VARIOUS WAVES ON THE COHERER. Leppin. "Wied. Ann.," 65, p. 885; abstracted briefly in "Elek. Zeit.," Nov. 17.—He showed that the coherer responded to sound waves when these waves act directly on it. If a telephone is connected in the circuit of a coherer, the latter will act as a microphone, the notes from whistles being especially clear. Heat waves will increase the resistance of a coherer which has been made conducting; a simple touch by the hand, for instance, is sufficient to produce an increase of the resistance. With light waves a distinction must be made between broad daylight and the direct light from the sun; the former will decrease the resistance, while the latter will increase it.

OSCILLATIONS ALONG WIRES. Morton. Lond. "Elec. Rev." and "Elec. Eng.," Nov. 18.—A brief abstract of his Physical Society paper on the propagation of damped electrical oscillations along parallel wires; it is discussed by Heaviside.

NATURE OF CATHODE AND ROENTGEN RAYS. Walter. "Wied. Ann.," 66, p. 74; noticed briefly in "Elek. Zeit.," Nov. 17.—If cathode rays are moving particles charged with negative electricity, as now generally accepted, then, according to this author, Roentgen rays are nothing more than the reflected cathode rays which have deposited their charge on the anti-cathode. This explains why X-rays are not deflected by a magnet, as the particles no longer carry an electric charge; that they have a higher penetrating power may be explained by the fact that when the particles carry a charge they are attracted by the body through which they are passing, while particles without a charge pass through them without meeting this opposing force.

CURRENTS PRODUCED BY ROENTGEN RAYS. Winkleman. "Wied. Ann.," 66, p. 1; abstracted at some length in the "Elek. Zeit.," Nov. 17.—He shows how a continuous current may be produced from one metal-plate to another, between which Roentgen rays pass.

REFLECTION OF CATHODE RAYS. Starke. "Elek. Zeit.," Nov. 17; abstracted from a German physical paper.—Description of experiments with the reflection of cathode rays. Platinum was found to reflect 36 per cent., brass 30 per cent., aluminum 21 per cent., and lampblack 17 per cent. of the incident cathode rays; these figures are not changed much when the voltage is increased from 6000 to 9000.

CONSTANT OF EARTH'S MAGNETISM. Eschenhagen. "Wied. Ann.," 65, p. 951; abstracted briefly in the "Elek Zeit.," Nov. 10.—The constants for the year 1897 at Potsdam, Germany.

MAGNETIC IRON ORE. Abt. "Wied. Ann.," No. 9; noticed briefly in Lond. "Elec.," Nov. 4.—He tested specimens of magnetite and found that they had a greater degree of remnant magnetism than steel manufactured by the puddling, the Bessemer or by the Martin processes, but they are surpassed in this respect by certain crucible steels and by tungsten steel.

ROENTGEN-LIGHT NOTES. Rollins. "Elec. Rev.," Nov. 30.—In this continuation of his notes he states that if a piece of insulated, opaque metal with a hole in it is placed very near the target, good results and sharp definition were obtained even from a highly excited tube. An improved tube of this kind is illustrated.

REFRACTION OF ELECTRIC WAVES. Bose. "Sc. Am. Sup.," Dec. 3.—A reprint from "Nature" of an abstract of his two Royal Society papers, one on the determination of the indices of refraction of various substances for the electric ray, and the other on the influence of the thickness of air space on the total reflection of electric radiation.

Electro-Chemistry and Batteries.

CHEMICAL THEORY OF THE LEAD ACCUMULATOR. Dolezalek. "Wied. Ann.," 65, p. 894; abstracted briefly in the "Elek. Zeit.," Nov. 17.—By an application of thermo-dynamic laws, and without involving any hypothesis, he believes himself justified in drawing a number of conclusions. The process in an accumulator is thoroughly reversible and may be represented by the usual equation in which both the lead and the oxide are converted into the sulphate during the discharge, and the reverse during the charge. The dependence of the voltage on the concentration of the acid corresponds with the changes in the free energy accompanying the changes in concentration of the acid. Of the new theories of accumulators only that of Liebenow and that of Le Blanc are in accord with the principles of thermo-dynamics, and are therefore claimed to be the only others that can be correct. The difference between the charging and discharging voltage is only due to the differences in concentration of the acid in the active materials. The equalization of the concentration in the active material is accomplished preferably, not by diffusion, but by local concentration currents; the metallic conductivity of the active mass in an accumulator is therefore of importance.

THEORY OF THE ACCUMULATOR. Hoppe. Lond.

"Elec. Rev.," Nov. 18.—A translation in abstract of the article which was noticed in the "Digest" Nov. 19.

OSMOTIC THEORY. Nernst and Bose. "Zeit. f. Elektrochemie," Nov. 17.—A short article describing some experimental results which refer to the osmotic theory and prove its application under certain circumstances.

ELECTROLYSIS OF ALKALINE CHLORIDES. Winteler. "Zeit. f. Elektrochemie," Nov. 3.—The conclusion of his long article describing various experiments which he has made (see "Digest," Sept. 10). No general conclusions seem to be drawn.

ELECTRO-DEPOSITION OF GOLD. Andreoli. "L'Elec.," Nov. 19.—The conclusion of his long article describing this process at the Transvaal.

NICKEL. Ulke. "Eng. Mag.," Dec.—An article on the mining, smelting and refining of nickel, at the conclusion of which the electrolytic process of refining is briefly described; this process is in use in Newark. The difficulty in depositing a thick plate of pure nickel is overcome by heating the solution, although he says that thick deposits can also be obtained from cold solutions under proper conditions.

Units, Measurements and Instruments.

AMPERE BALANCE. Ayrton and Jones. Lond. "Elec. Eng.," Nov. 18.—A reprint of a very short Brit. Assn. paper describing briefly an apparatus designed and constructed by them which was used in their preliminary investigation of the redetermination of the electrochemical equivalent of silver—that is, the determination of the ampere in terms of the silver equivalent. This method is the one they used after considering a number of different ones. "On a vertical cylinder about 17 inches high and 6.8 inches in diameter we wound two coils about 5 inches in height, separated by an axial distance of 5 inches. The coils consisted each of a single layer of about 170 convolutions of wire, and were wound in opposite directions. From the beam of a balance there was suspended, inside this cylinder, a light bobbin, about 4 inches in diameter, on which was wound a coil about 10 inches long, consisting of a single layer of 360 convolutions, and the whole apparatus was so adjusted that when the beam of the balance was horizontal the inner and outer coils were co-axial and the top and bottom of the inner suspended coil were respectively in the mean planes of the outer stationary coils." This arrangement was used because the geometric measurements could be accurately determined and convenient formulas could be used. A certain current was determined absolutely by this means, and it was found that the silver value of the true ampere was so nearly equal to the usual value, namely, 1.118 m.g. per second, that it would require an apparatus still more perfectly constructed to enable the error in this value to be ascertained with accuracy. They have made working drawings of such an apparatus which it appears is to be constructed.

MEASURING ELECTRIC QUANTITY. Blondlot. "Jour. de Phys.," Oct.; abstracted briefly in Lond. "Elec.," Nov. 18.—A description of his novel method of measuring the quantity of electricity directly in electromagnetic units, and a meter based on it. The method was described in the "Digest" Aug. 6. There is a movable coil inside of a fixed one, the same current flowing through both; he shows that the quantity passing during one oscillation always remains the same; hence the total quantity is given by the number of oscillations; this quantity in absolute units is equal to the square root of the fraction whose enumerator is the moment of inertia of the movable coil multiplied by 3.1416, divided by the product of the number of turns of the fixed coil per centimetre of length, by the area of the ring. In the meter the oscillations are only in one direction, and the current breaks the current at each oscillation. The apparatus is said to follow any sudden variations of the current strength with the greatest promptness.

MAGNETIC FLUXES IN ELECTRICAL INSTRUMENTS.—Lond. "Elec. Rev." and "Elec. Eng.," Nov. 18.—An abstract of the discussion at the Physical Society of Campbell's paper (see "Digest," Nov. 26). Ayrton, among other things, discussed the effect of the earth's field, which is of the order of 0.2, on the Weston instruments, the field of which is on the order of 1000; it is sometimes erroneously assumed that the readings are practically independent of the earth's field; by putting such a voltmeter in different positions with respect to the compass the errors were far greater than might be predicted from the above ratios; the earth's field was exaggerated by the iron pole pieces; the error was about 0.2 per cent. "in the horizontal field," and 0.8 per cent. when the field of the voltmeter was parallel to the earth's induction; the induction of the gap was 1200. Reeves described a method for measuring the effect of stray fields on ammeters and voltmeters; the instrument is mounted on a stand and is brought under the influence of a large coil carrying a current; fields of known magnitude can thus be superimposed on the working field; from these known values the working field can be deduced. Campbell states that his results with the Weston instruments differed from those of Ayrton; the error which he had observed was below 0.1 per cent. He suggests that the effect may be different in different instruments according to the degree of saturation of the permanent magnet.

TESTS OF SHEET IRON. Kolben. "Elek. Zeit.," Nov. 10.—A short communication referring to the articles by Roehr, noticed in the "Digest" Nov. 26. He refers to some tests made by him in 1896 in which he showed that at the usual magnetic induction of 5000 the loss in a certain English sheet iron for transformers was 8 watts per cb. dm., while in normal soft-charcoal iron sheets it is just twice as great. The chemical analysis of these is also given, and shows that the percentage of manganese was considerably greater in the latter; these show that carbon, silicon and manganese all three (together) tend to make the iron poorer for magnetic purposes. This is followed by a short communication by Niethammer also discussing the same article. In the issue of Nov. 17, Roehr replies to these critics. Regarding the remarks of Kolben he states that conclusions may be drawn regarding the combined action of those ingredients, but not with reference to the effect of each single one. To Niethammer he replies that the original object was to determine whether it will suffice in practice to take a sample of a few strips instead of making a test transformer.

INDUCTION COIL-BREAK. Villard. "L'Eclairage Elec.," Nov. 12.—An abstract of a French Physical Society paper. He states that the apparatus contains no mechanisms, nor does it require an external source of energy. The movements are produced by the vibrations of an elastic strip securely held at the two extremities; it is provided with a point, which dips into mercury; it is placed in the magnetic field, and whenever a field exists the action is to break the contact; the energy required is less than 1 watt. The description is not quite clear.

MEASURING VERY HIGH VOLTAGES.—"L'Elec.," Nov. 19.—A translation in abstract of the article by Peukert, noticed in the "Digest" Oct. 22, describing his method.

PRONY BRAKE. Wetler. "L'Eclairage Elec.," Nov. 12.—A translation, with the illustrations, of the article noticed in the "Digest" Oct. 22.

Telegraphy, Telephony and Signals.

PROTECTING TELEGRAPH AND TELEPHONE LINES.—"L'Eclairage Elec.," Nov. 12.—An illustrated reprint of a circular issued by the Government telegraph department in Switzerland, concerning the protection of such lines against strong electric currents; a number of diagrams are given.

CALCULATION OF A PRIMARY BATTERY FOR CHARGING ACCUMULATORS FOR TELEGRAPHY. Brunelli. "L'Eclairage Elec.," Nov. 5.—A long abstract of his article, which was noticed in the "Digest" July 23.

EARTH PLATES.—"Science Abstracts," Nov.—An abstract of an article describing the experiments made with various forms of earth plates, by the telegraph department of Germany. It is apparently the same article as was noticed in the "Digest" Jan. 1, 1898.

TELEPHONE INDICATOR.—Lond. "Elec. Rev.," Nov. 18.—A brief, illustrated description of the Rabbidge indicator, for which great simplicity is claimed; it is intended to replace the shutter indicator on telephone switchboards.

TELEPHONE SWITCHBOARD. Dubreuil. "L'Elec.," Nov. 12.—In this continuation of his article he discusses the details of multiple switchboards, with special reference to the method of facilitating the action of the annunciators when the attendant calls a subscriber.

MODERN TELEPHONY. Wehrenalp. "Zeit. fuer Elek.," Nov. 13.—In this continuation of his long, illustrated series he discusses telephone centrals and their construction.

BELL SIGNALS.—"Zeit. fuer. Elek.," Nov. 13.—In the issue of September 4 of that journal there was described a system of telephone and bell signals used on the Austrian railways; in the present short, illustrated article a new system of connection for this system is described, which is said to simplify it. It has the advantage that the bell signal will be received at all the stations even when the telephone is in use at the time.

SUB-MARINE TELEGRAPHY. Bright. "Eng. Mag.," Dec.—An article on the extension of sub-marine telegraphy during the past quarter of a century. It includes a map of the world, with all the cable lines. In conclusion he says that far more capital is invested in sub-marine telegraphy than in any other branch of electrical industries, and that it amounts to about $225,000,000.

PARTY LINES. Miller. "Elec. Eng'ing," Nov.—In this continuation of his long serial he discusses what are termed "strength and polarity systems"—that is, those which depend for their operation on changes in strength or in the direction of the current, or both; at present all the party lines successfully using selective signaling are operated on this general plan.

PRIVATE TELEPHONE LINES.—"West. Elec.," Nov. 26.—A short, illustrated article calling attention to the fact that it is false economy to endeavor to use the same battery for a local telephone line that is used for electric gas lighting; it is shown that under certain conditions the battery will be short-circuited through the telephone switches.

PAY STATIONS IN PARIS.—"Elec. Eng.," Dec. 1.—A note stating that the French Government intends to provide for a number of sub-stations in different parts of the city, with waiting rooms attached; the cost is to be 5 cents per message.

TELEPHONE PATENTS.—"Electrical Engineering and Telephone Magazine" publishes a monthly digest of telephone and kindred patents, under the direction of Clement; short, illustrated descriptions are given.

ANCIENT METHODS OF TELEGRAPHING. Irwell. "Elec. Eng'ing," Nov.—A short article describing methods of signaling used by the ancients and up to the beginning of this century.

MINE SIGNALS. Clements. "Eng. and Min. Jour.," Nov. 26.—An abstract of a paper read before the South African Society of

Electrical Engineers. After referring to the various systems of signaling in mines he describes the usual electric system, which he considers to be the best.

Miscellaneous.

ELECTRIC HEATING.—Lond. "Lightning," Nov. 17.—A brief, illustrated description of a bindery in London where electricity is used to a considerable extent for heating, the current being generated by means of a gas engine and used also for lighting. Electricity is used for heating the small tools used in gilt lettering, for heating the glue pots, sealing wax, and ovens for heating the backs of books. The energy used is 20 to 22 units per day (presumably kw hours), but it is steadily being reduced as the workmen learn the importance of turning off the heat. There is an actual saving in the quantity of gas used, as compared with the former output when the heating was done by gas. The lighting plant had to be increased but slightly in order to supply the heating current, thus involving but little increased capital expenditure. The plant also includes a storage battery.

ELECTRIC WORKING OF METALS. Brillie. "Rev. Gen. des Sciences," Nov. 15.—A long article giving illustrated descriptions of the various processes and machines which are in use for electrical heating, welding, brazing, and fusing metals. The article is of the nature of a summary of the various processes.

REGULATING APPARATUS FOR RESERVOIRS. McPherson. Lond. "Elec. Eng.," Nov. 11.—A brief abstract of a recent paper describing an apparatus.

MECHANICAL APPLICATIONS. Richard. "L'Eclairage Elec.," Nov. 12.—An illustrated article giving brief but well-illustrated descriptions of numerous mechanical applications of electricity taken from patent specifications.

ELECTRICITY FOR POPULARIZING HEALTH RESORTS. Hulme. Lond. "Elec. Rev.," Nov. 18.—An article calling attention to the effect which the introduction of electric light and power has had in the development of Blackpool.

PRIZE.—The French Academy of Sciences has this year awarded for the first time the Houllevigue prize of $1000; it was awarded to the French physicist, Branly, for his coherer.

PLATINUM.—"Eng. News," Dec. 1.—A note from the United States consular report stating that 95 per cent. of the entire amount of platinum mined in the world during 1897 came from Russia, the entire amount being about 6 tons. A table gives the distribution among the various mines.

New Books.

ELEMENTS OF SANITARY ENGINEERING. By Mansfield Merriman, Professor of Civil Engineering, Lehigh University. Published by John Wiley & Sons, New York. Octavo, 216 pages. Price, $2.

TWENTIETH CENTURY MAGIC. By Nevil Monroe Hopkins. New York: George Routledge & Sons. 160 pages, 100 illustrations. Price, $1.

This work contains one chapter devoted to electrical magic as presented already in serial form in the "American Electrician."

PATENTED TELEPHONY. Published by the American Electrical Engineering Association, Chicago, Ill; 102 pages, with illustrations from patent specifications. Price, $1.50.

This work is intended as a reference work for telephone designers and patent lawyers and as a guide to those in doubt as to the patent situation. It takes up the chief points of the American controlling patents, these being properly classified, and discusses some of the Supreme Court decisions and their bearing on the present state of the art.

ALTERNATING-CURRENT WIRING AND DISTRIBUTION. By William Le Roy Emmet. New York: The Electrical Engineer. Second edition, revised and extended. 98 pages, cloth. Price, $1.

Many a station manager who finds the wiring of direct-current circuits plain sailing is at sea when planning alternating-current lines, in which he wishes to take into account the inductive drop on lagging or motor loads, and particularly in laying out multiphase lines. This little work will help those so situated out of their difficulties, and aid them to a clearer comprehension of such subjects as synchronous and induction motors and rotary converters, the use of synchronous machines for regulation, wiring of alternating-current motors and other subjects.

THE METRIC SYSTEM OF WEIGHTS AND MEASURES, published by the Hartford Steam Boiler Inspection and Insurance Company, Hartford, Conn. 196 pages. Price, $1.25.

The primary object of this work is to minimize the labor of translating the metric units into their English equivalents, and vice versa, by the use of a very complete set of tables. Of the 106 pages of the book 148 pages are taken up by the tables, which cover long measure, square measure, land measure, cubic measure, liquid measure, dry measure, measures of mass and miscellaneous tables. An interesting history of the meter is given at the beginning of the book, in it being pointed out the origin and diversity of systems in use. The most striking features of the tables are simplicity of arrangement and clearness of type, both of which will render the work of value to the busy man. The book is of a convenient size to carry in the pocket.

HARPER'S SCIENTIFIC MEMOIRS. An opportunity for students not situated within reach of great libraries, in which they may obtain original papers on important points, is to be given in a series of works published by Messrs. Harper & Brothers, entitled "Harper's Scientific Memoirs." These will contain such original documents of value translated and edited by Prof. Joseph S. Ames, of Johns Hopkins University, with the assistance of many other noted scientific scholars. Two volumes are now ready, one entitled "The Free Expansion of Gases," containing memoirs by Gay-Lussac, Joule and Thomson, the other containing Fraunhofer's papers on "Prismatic and Diffraction Spectra." They are printed in thin octavo volumes, the first one mentioned above having 102 pages and sold at 75 cents; the other 65 pages, its price being 60 cents.

COMMERCIAL CUBA. By William J. Clark. New York: Charles Scribner's Sons. 500 pages, with illustrations and maps. Price, $4.

All electrical engineers will take particular interest in this work owing to the relations of its author with the electrical industries, Mr. W. J. Clark being well known as the manager of the electric railway department of the General Electric Company. Where Mr. Clark has found time with his other multitudinous duties to compile this elaborate and complete compendium of useful and valuable information about Cuba is a mystery, but in spite of the author's duties in other lines the work is a very thorough one. Beside being valuable as a work of reference it is eminently readable and almost as entertaining as a work of fiction, the personal and social peculiarities of the Cuban people being dwelt upon, so that those having dealings with them may know how to treat them. To all intending to enter into commercial relations with this new colony of the United States this work is a sine qua non, and anyone interested in the subject of which it treats will find its perusal of value.

MATTER, ENERGY, FORCE AND WORK. By Silas W. Holman, Professor of Physics, Massachusetts Institute of Technology. New York: The Macmillan Company. 257 pages. Price, $2.

Under this broad title there is presented a plain and simple explanation of many of the fundamental ideas and principles of physics. The work does not pretend to present the experimental side of the subject, but to develop in the mind of the reader, who is assumed to have some knowledge of these, a clear idea of many of the fundamental conceptions which the practical man often finds it hard to grasp, and the loss of which seriously embarrasses him often more than he knows in his study of the applications of science in the industries. Only those who personally know Professor Holman can appreciate the great care he has taken in the preparation of this work, the logical simplicity of his explanations of rather intangible subjects, and the interest which the reader will be surprised to find in such a dry subject; all of which are due to the author's almost affectionate enthusiasm for this particular line of work. Those who have struggled with the conceptions involved in the absolute system of units; who have tried to get a mental grasp of the dimensions of the physical quantities; who have tried to understand that electromotive force is dimensionally considered the product of length to the three halves power, mass to the one-half power, and time to the minus second power, will find their ideas most wonderfully clarified by reading this work. The presentation of speculations on matter and energy, discussing such things as the vortex-atom theory and the nature of energy and matter, are as delightful reading to a student of science—even one not versed in the higher mathematics—as is a work of fiction.

ENGINEERING CONTRACTS AND SPECIFICATIONS. By J. B. Johnson, Professor of Civil Engineering, Washington University. Second Edition, Revised. New York: The Engineering News Publishing Company. 450 pages. Price, $3.00.

This work contains a synopsis of the law of contracts and a complete list of descriptive and technical clauses of various kinds of engineering specifications, among them being the following specifications of value to electrical engineers: Specifications for excavations and embankments; for cement, mortar, concrete and masonry; for various classes of iron and steel work; for pile and trestle bridging; for the steam plant of a small electric light station; for leather driving belts; for turbine water wheels; for the installation of an electric lighting station in a small city, and for electrical distribution circuits for light and power. The work has been prepared for the use of students, engineers and contractors, and should be particularly valuable to consulting engineers who wish a general outline of specifications in which they can embody their own individual ideas and needs. The specifications are made complete and carefully worded, and in one part of the work are given illustrative examples of complete contracts and specifications. These are taken from the work of many famous engineers, some of those well known to electrical men being B. J. Arnold, of Chicago; William H. Bryan, St. Louis; Richard McCulloch, St. Louis, and J. T. Fanning, of Minneapolis.

The complete index and the careful marginal side heads of these various specifications make this work a valuable one to the consulting engineer, the contractor or the builder.

LA TRACTION ELECTRIQUE SUR VOIES FERRES. By André Blondel and F. Paul-Dubois. Two vols., 1700 pages and 1014 illustrations. Baudry & Cie., Paris. Price in U. S. $11.

Perhaps, taken altogether, this is the most notable electrical book of the present year. It covers the field broadly, not only in the variety of subjects dealt with, but also in the manner in which the different aspects of each particular subject of development are treated. It is not only new to find embodied in one treatise so many valuable hints concerning modern practice, but it is of exceptional value and interest to the reader to have them presented and described as illustrative of fundamental principles. From the opening chapter to the end of the book the interest is well sustained, and the treatment of a most important phase of electrical work is handled adequately and accurately; indeed, the range of information—which extends as one may say from theoretical investigation to practical costs—is unique.

Heretofore, strange to say, books on electric traction have chiefly treated of the distribution of electric power to the cars, and have neglected traction proper. The present volumes deal exhaustively with electric traction as a topic in itself, and on the following general plan:

A first part, dealing with rolling stock and appliances, and a second part covering the technical details of traction proper.

It will appear to the reader, however, that many desirable additions have been made to the initial plan, which come in due place in the two volumes. Thus Vol. 1 contains a treatment of track construction, electric motors and trucks—with scale drawings of motors and complete data—electric locomotives, etc. The second volume follows with principles and details of the alternating and direct current motors, regulation, braking, etc.

Among so much that is valuable it is difficult to select particular portions, but perhaps Chapter VII. may be taken as fairly illustrative of the completeness of detail of the book upon a given subject. Here we have an exhaustive study of all kinds of electric locomotives. After a reference to historical failures in that line, the authors then trace the rational evolution of the electric locomotive, both in the United States and Europe, it being shown that in practical results American workers took the lead. Then follows a detailed analysis of the logical requirements of locomotive construction, and an elaborate comparison of electric and steam locomotives under all conditions and aspects.

Chapter II. is devoted to alternating polyphase motors, and is a thorough study of all the prominent applications. In a final comparison of alternating and direct current motors, the authors conclude that the most serious difficulties in the use of alternating currents do not arise from the operation of the motor itself, but are due to the awkward nature of the distribution, which fact limits their use to but special cases.

There are two valuable appendices; one referring to generat costs and running expenses, the other to a discussion of the conditions of safety of operation. In the second appendix there is a complete exposition of the subject of electrolysis, including an up-to-date consideration of the vital question of electrolytic effect on pipes, bridges, etc., which has attracted so much attention of late.

There are also numerous valuable indices, containing supplementary detail matter in regard to forms, specifications and designs, together with annotations on the text itself. The whole work is profusely illustrated. That the compilation of this book cost an enormous amount of painstaking effort goes without saying, and that the information is so accurate is matter for congratulation as well as surprise, in view of the vastness of the field.

As above mentioned, the distribution of electrical energy as a general subject does not find a place in these books, but this will be treated in a third volume to be written by the same authors, thus completing the treatise.

The Woods Electric Motor-Vehicle.

By the courtesy of the Fischer Equipment Company, of Chicago, Ill., sole manufacturer of the Woods motor-vehicles, THE ELECTRICAL WORLD is enabled to present to its readers some interesting facts concerning these carriages.

The work of Mr. Woods has been exclusively toward the production of fine artistic carriages in all the various styles known to the carriage makers' trade rather than the mere production of a self-propelled machine. The company is now offering some twenty-five different styles of vehicles covering the same range of diversity in design as is found in any of the large carriage manufacturers' catalogues. The company's factory is well equipped for this class of work, and it manufactures the complete vehicle, including everything that is used in the building up of the carriage, except the rubber tires.

Fig. 2 represents the Fischer Company's victoria hansom cob, which is equipped with two 3½-hp motors, and has sufficient battery capacity to run 30 miles on one charge. It is designed for use on city streets and to run at a maximum speed of 12 miles an hour. In another design of the hansom cab the driver sits back of the passengers instead of at the front of the vehicle, as in the former case. The finish of these vehicles is said to be first class, and their manipulation is reduced to such a degree of simplicity that a driver of ordinary intelligence can readily learn to operate them. The total weight of these cabs is 2600 pounds each.

The lightest road buggy built by the company is illustrated in Fig. 1, the total weight of this vehicle being but 750 pounds. The equipment consists of one 2½-hp motor, with sufficient battery capacity to run the vehicle 25 miles on one charge at a maximum speed of 12 miles an hour. It has a seating capacity for two passengers.

A peculiar feature of the Woods vehicle is that wooden wheels and hard-rubber tires are used almost exclusively. The company has by practical tests demonstrated to its own satisfaction that the latter are far more desirable and durable in many ways than the pneumatic tires. They not only present a more graceful appearance, but consume less power and are free from all the annoyances due to punctures, etc.

In the control and operation of these vehicles it is said to be impossible to apply the brake without first cutting off the power from the motors, and, conversely, it is impossible to apply the power without first releasing the brake. This result is accomplished by an interlocking device between the brake and controller. A separate reversing switch is used by which these vehicles operate in exactly the same manner when running backward as they do in their forward movement. This reversing switch is provided with a lock, so that when the key is removed the vehicle cannot be operated by anyone not in possession

FIG. 1.—LIGHT ROAD BUGGY.

of the key. The various speeds are obtained by series paralleling the batteries, and great pains have been taken to secure a uniformity of discharge of the batteries while in parallel. The contacts and connections have nearly four times the cross section ordinarily required. On the light road buggy, but one motor is used with a differential gear. Aside from this one departure all of the Woods vehicles for hard and heavy work are equipped with two motors, one being attached to each rear wheel. Every provision is made for automatic adjustment in the turning of corners or in turning the vehicle around.

The motors are built with ironclad armatures and special coil windings, which are wound before being placed on the armature. The batteries are so arranged that they may be removed from the vehicle in order to replace them with duplicat sets of they may be charged in situ.

It is stated that an absolutely noiseless gear has been obtained after a long series of experiments, special compositions in rawhide being used for the purpose.

The lightest of the vehicles manufactured by the Fischer Company is the road wagon, which weighs 750 pounds complete. On one charge of the battery it is capable of covering 20 miles at a maximum speed of 14 miles per

FIG. 4.—VARIOUS TYPES OF WOODS ELECTRIC MOTOR-VEHICLES.

hour. It requires three hours' time to recharge the batteries, of which there are forty cells. The diameter of both the front and back wheels is the same, namely, 32 inches. It is capable of climbing a grade of 5 per cent., and according to data given out by the company it can be operated at a cost of three-quarters of a cent per mile. The heaviest vehicle in the list is a theatre bus,

FIG. 2.—VICTORIA HANSOM CAB WITH DRIVER'S SEAT IN FRONT.

weighing 3500 pounds complete, and is capable of traveling 25 miles on one charge of the forty cells of battery. It has motors of 9½ horse-power capacity, and its maximum speed is 8 miles per hour. It is stated that this vehicle can be operated at a cost of four-tenths of one cent per mile. Between the vehicles above referred to there are many other sizes and classes. The maximum speeds vary between 10 and 16 miles per hour, and the cost of operation ranges between the limits given in connection with the two vehicles above referred to.

An Electric Forge Blower.

The cut in the next column shows an adaptation of small induction motors for use in the operation of forge blowers. This is said to be not only the cheapest, but also the best method of furnishing a blast for all sizes of black-

FIG. 3.—VICTORIA HANSOM CAB WITH DRIVER AT THE BACK OF PASSENGERS.

smith forges. The air pressure is stated to be much heavier than can be produced from bellows or hand blowers, and in addition it allows a workman to perform at least one-fourth more work, since the blast is ready at all times, and it is not necessary for him to give any of his time to producing air pressure. It is stated that a great many of these machines are being used in some of the largest blacksmith shops in the country, and are giving the best of satisfaction. By the use of this blower it is possible to get an even welding heat much quicker and better than can be done by any other means. The motors furnished with this apparatus are of the induction type, which, having no brushes,

ELECTRIC FORGE BLOWER.

commutator or other parts requiring adjustment or repair, are particularly adapted to this class of work. Further information regarding this apparatus will be gladly furnished by the Emerson Electric Manufacturing Company, St. Louis, Mo. This blower is recommended for use in central stations.

Instruments and Methods Used in Telluride High-Voltage Power Transmission Measurements.*

APPENDIX A.

[Extract from report of Mr. Mershon.]

At first, all the measurements of power were made in the low-tension circuit. The attempts to measure the power delivered to the line by taking the difference in the readings of the wattmeter in the low-tension circuit of the transformers when the lines were on and when they were off, proved worse than useless. This was due to the fact that throwing on the lines distorted the e. m. f. wave impressed on the transformer. As a result, at low voltages, readings obtained in this way indicated a negative line loss, and it was only when the voltage was raised to such a point that the line loss was greater than the reduction in iron loss, due to the e. m. fs. distortion, that positive results could be obtained; such results were of course incorrect. In order to overcome this, it was determined to balance on the wattmeter the effects of the iron loss in one of the power transformers against that of the other in such a manner that both transformers would be subject to the same e. m. f. distortion, and the iron loss would therefore at no time register anything on the wattmeter. The line loss could then be measured directly. This was accomplished as is shown in Fig. 18.

Here the transformer which supplies the line is designated as the "power transformer," while that which is used in balancing the iron loss of the power transformer is called the "balancing transformer." As was stated in the description of the transformers, the power transformer has four of its low-tension coils in multiple for receiving power, while the fifth or middle low-tension coil is independently used in connection with the measuring instruments. This middle coil of each transformer is shown in the sketch, and it is through these coils that the balancing transformer receives its voltage. That is, one-third of the middle coil of the power transformer feeds one-third of the middle coil of the balancing transformer. With such an arrangement, the balancing transformer receives practically the same wave form as that impressed upon the balancing transformer, no matter what the amount of wave form distortion may be. *A* is the field coil of the wattmeter. It has two windings. Through one of them, the primary winding, passes the current to the power transformer; through the other, the secondary winding, passes the balancing current—the current to the balancing transformer. As these currents are in opposite directions in their respective windings, when adjusted to the proper values, their effects on the shunt coil of the wattmeter annul each other. It is evident that if *A* only were used, a balance for iron loss when the lines were off would not necessarily mean a balance when the lines were on, because the change in current due to putting the lines on would cause a change in the reactance e. m. f. of the secondary of the wattmeter field coil, and consequently a change in the balancing current through this secondary. The air transformer *B* is therefore used; *B* is preferably, but not necessarily, exactly similar to the field coil *A*, and supplies an e. m. f. in its secondary exactly equal to and in step with that of the secondary of *A*. These two secondaries are connected in series, so that their e. m. fs, oppose, and through them both is sent the balancing current. The secondaries of *A* and *B* are not connected directly in series with the circuit connecting the middle coils of the power transformer and balancing transformer, but are included in this circuit through the medium of a series transformer, *C*. *C* makes possible the adjustment of the balancing current to the value necessary for zero wattmeter reading when the lines are off, and it, or some equivalent device, is necessary because of the impossibility of securing two transformers with exactly the same iron loss. Indeed, in this particular case the ratio of the hysteresis to the Foucault current loss differed sufficiently in the two transformers to necessitate adding in shunt to one of

*Continuation of paper by Chas. F. Scott, presented before the American Institute of Electrical Engineers, Omaha, June, 1898. See THE ELECTRICAL WORLD of November 26 and December 3.

them an ohmic resistance which made up for the lack of Foucault current loss in it. This method of reading power is, if properly carried out, a most admirable one, and has the advantage that the instruments to be handled are all in the low-tension circuit. The balance may be obtained without difficulty, and when once properly obtained holds through all ranges of voltages and distortions of wave form. Tests of this balance were made repeatedly with the lines off, by varying the impressed e. m. f. through wide ranges and distorting the e. m. f. wave, the distortion being produced by introducing in series with the

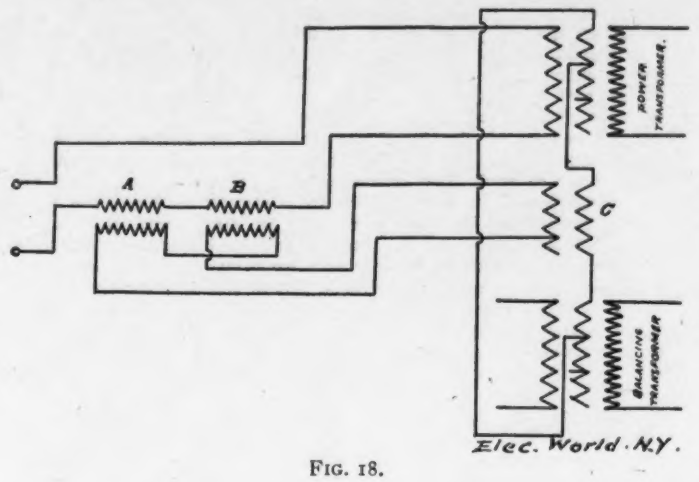


FIG. 18.

power transformer large amounts of both resistance and reactance. In every case the balance was perfectly preserved. There is one drawback, though not a serious one, to the method as here employed. The power transformer, because of the load upon it, heats up faster than the balancing transformer, and the balance is in consequence impaired. The amount of unbalancing is, however, small, even for wide difference of temperature, and it can be easily corrected for by means of zero readings taken before and after a set of observations. This unbalancing, due to unequal heating, could be rendered negligible by placing the power transformer and the balancing transformer in the same tank of oil.

Although in this case the balancing transformer was of the same size as the power transformer, it may be much smaller, though both transformers should be worked at the same induction. Of course, it is not necessary that the balancing transformer have a full set of windings. It need only have a coil suitable for receiving e. m. f. impressed upon it.

The wattmeter actually used in this work (shown in Fig. 19) consists of a field coil so mounted that a Weston wattmeter can be slid in and out of it, and different ranges thus obtained. The scale originally on the wattmeter was replaced by one of equal parts. The wattmeter's own field coil is not used at all, the field being supplied wholly by the large external field bobbin. The voltage impressed upon the wattmeter shunt coil was at first obtained from the auto-transformer above mentioned, but later it was obtained directly from one-third of the middle coil of the power transformer by the use of an additional resistance of multiplier. The winding of the field bobbin consists of twenty-seven turns of a cable composed of seven No. 8 double cotton-covered magnet wires which were twisted together after having been separately treated with "P. & B." insulating compound.

The wires are brought out separately to terminals on the top of the bobbin, and can be used singly or in any desired series or multiple combination. They were, for this work, connected up into two sets, forming the primary and secondary of the wattmeter coil. The size of this field coil, necessitated by the size of the wattmeter box, gives it a

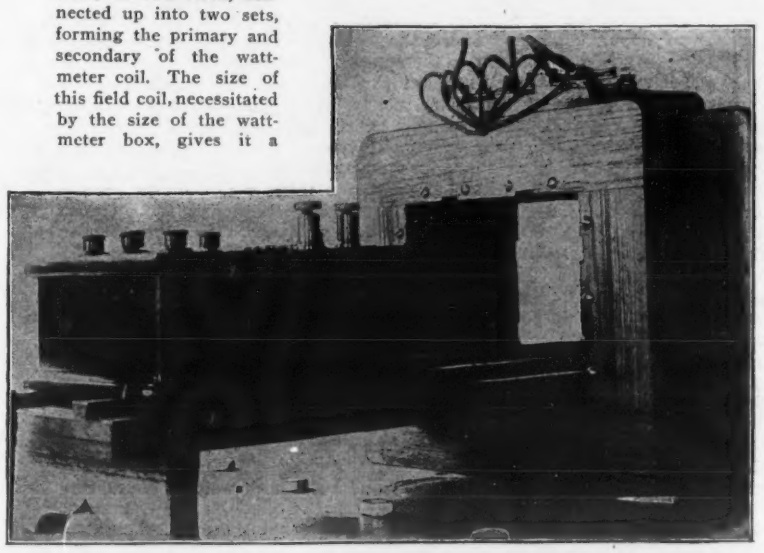


FIG. 19.—WATTMETER WITH EXTERNAL COIL, USED IN TESTS AT TELLURIDE.

large reactance, and as this has added to it the equal reactance of the air transformer, the reactance of the combination is considerable. This is objectionable because of the consequent distortion of the generator e. m. f. wave, for though the results obtained under these conditions are accurate, they are in some cases the results of conditions differing widely from those which will ordinarily be met with in practice. The combined reactance of the field coil and the air transformer at a frequency of 60, when passing a current taken by a power transformer supplying the line, is 2.83. The current used in obtaining this figure probably differed somewhat from a sine wave. If the wattmeter were specially constructed with a view to this work, the movement being surrounded as closely as possible by the protecting case, the external field coil into which the movement projected could be made small enough to reduce the reactance to a negligible quality. In designing a wattmeter for this work it should be borne in mind that it must measure under the condition of a very small power-factor.

In these notes the term "Weston Wattmeter" is meant to include the field bobbin of the wattmeter and the air transformer used in connection with it.

After the above wattmeter had been in use for some time another was obtained for use in the high-tension circuit. It is a Thomson inclined-coil instrument, whose field coil was rewound for this work. In connection with this wattmeter are two external resistances—the one with a resistance of 1,202,300 ohms, for use in series with the shunt circuit of the wattmeter; the other with a resistance of 3495 ohms being equal to that of the wattmeter shunt circuit and intended for use in shunt to the latter, in which case the wattmeter shunt coil receives only one-half of the current in the shunt circuit. When in use, the case of the wattmeter was connected to one of the wattmeter shunt terminals, so that the inside and case of the wattmeter were always at the same potential and the case formed a screen against any external electrostatic effects. This wattmeter was of considerable value as furnishing a means of studying the effect of the distortions due to the Weston wattmeter, and also to the readings at low frequency, since in the latter case it was necessary to use both transformers as power transformers, which left nothing for use as a balancing transformer. In the notes this wattmeter is designated as Thomson wattmeter.

The ammeters used were two Thomson inclined-coil instruments. They had a capacity of one-half and two and one-half amperes respectively. They were put directly into the high-tension circuit, the cases being connected to one terminal of the instrument.

The method of taking wave forms was that devised and published by the

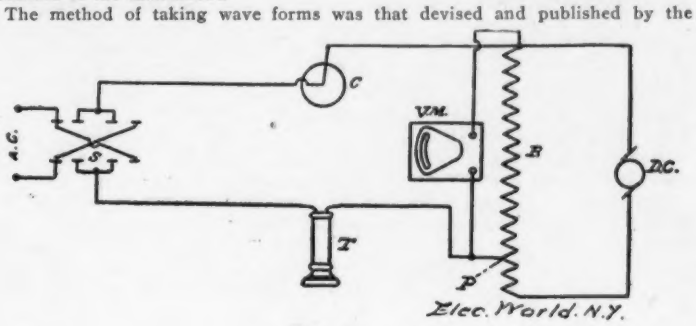


FIG. 20.

writer (Mr. Mershon), in 1891. It is an instantaneous potentiometer method, employing a telephone receiver to indicate a balance. The connections are those shown in Fig. 20.

A C is the source of the alternating e. m. f., whose wave form is to be plotted, *S* is a double-pole switch for reversing the alternating current terminals, *C* is the usual instantaneous contact device, *T* is a telephone receiver. *V. M* is a d. c. voltmeter—in this case the Weston laboratory standard *R* is a resistance along which the contact *P* can be moved. *D C* is a source of direct current—in this case a direct-current dynamo feeding the resistance *R*. The contact *C* being set at any desired point, the value of the e. m. f. at the instant of contact is determined by moving *P* backward or forward until there is no sound in the telephone *T*. The reading of the direct-current voltmeter *V M* gives the desired value. The e. m. f. *A C* was obtained from the same source as the e. m. f. for the a. c. voltmeter, i. e., from an auto-converter connected across one-third of the middle coil of the power transformer.

The indication of proper speed, or rather frequency, was obtained from the vibration of a weighted steel wire hung in front of the poles of an alternating electro-magnet energized by the machine supplying power. The wire always vibrated at the frequency for which the suspended weight was adjusted, and ceased to vibrate when there was any appreciable deviation from this frequency.

APPENDIX B.

CALCULATED CHARGING CURRENT TO TWO PARALLEL WIRES.

Length, 1 mile; 10,000 Volts; Sine Wave.

The charging current to a single-phase line 1 mile long has been calculated from the formula for capacity between wires and on the assumption that the e. m. f. is a sine wave. The results are given for several cases, and as the variations between the quantities given are not very great, intermediate values can be readily interpolated. The current varies directly as the length of line, the voltage and the frequency.

Size of Wire—B. & S.	No. 8.	No. 4.	No. 1.	No. 0000.	1 diam.
Distance between centres of wires.	Amperes at 60 cycles.				
12 inches.	.032	.035	.038	.0414	.053
24 "	.0284	.0309	.0328	.0362	.043
48 "	.0252	.0274	.029	.0313	.0309
	Amperes at 25 cycles.				
12 inches.	.0133	.0146	.0158	.0172	.0221
24	.0118	.0129	.0137	.0151	.0179
48	.0105	.0118	.0121	.0130	.0154

NEWS OF THE WEEK

Financial Intelligence.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, Utica, N. Y., has increased its capital stock from $16,000 to $75,000.

GENERAL ELECTRIC DIVIDEND.—The directors of the General Electric Company on December 2 declared a dividend of $17.50 on the preferred stock. This pays up one-half of the accumulated dividends, leaving yet to be paid up to August, 1898, $29 per share. The unpaid cumulative dividends now aggregate $763,942. On October 24 last the directors declared a distribution of $11.66⅔ per share on the preferred stock as reduced, to be applied on account of the unpaid accumulated dividends. This declaration called for the payment of $297,640, leaving at that date unpaid accumulated dividends standing of $1,230,245. The second dividend is payable December 22.

Special Correspondence.

NEW YORK NOTES.

HONORING COLONEL GRIFFIN.—A complimentary dinner was given for Col. Eugene Griffin at Sherry's on Thursday evening last by the officers of the First Regiment, United States Volunteer Engineers. Several prominent army and navy officers were present.

"WHAT WILL OUR COUNTRY SAY OF US?" (A Reverie of the Army of Santiago) is the title of a song just published, the words and music of which are by Gen. C. H. Barney. General Barney is one of the best-known old-timers in the telephone field. He has for many years been connected with the New York Telephone Company, and was formerly a member of the firm of Alexander, Barney & Chapin. Outside of its merits the song does credit to General Barney's patriotism.

SPECIAL CARS FOR PACKER STUDENTS.—The Packer Institute girls in Brooklyn have received a special distinction at the hands of the Brooklyn Heights Railroad Company, which ordinary mortals do not enjoy. The company has assigned three of its cars for their exclusive use to convey them to school. These cars start in the morning from the Broadway Ferry, Fulton Street and Reid Avenue, and Flatbush Avenue and Clarkson Street. Each car carries a sign reading "Packer Institute Car." It is stated that if the experiment is successful special trolley cars will be assigned for the use of scholars of other large schools.

MR. ALBERT L. JOHNSON, president of the Nassau Electric Railroad Company, Brooklyn Borough, returned home from Europe on Saturday night last on the steamer "Campania." It is stated that Mr. Johnson went to London to interest certain persons in the project of establishing a trolley system in that city. He is encouraged with the results of his trip. He asked the London authorities for a certain privilege to demonstrate what he could do in the matter of bettering the means of intramural travel in London, and states that he has reason to believe that the privilege will be granted. Mr. Johnson declined to make any definite statement regarding the project, but promised to say more on the subject next spring, when he expects to return to London.

THE POSTAL TELEGRAPH BUILDING SCORCHED.—The fire which on Sunday night last destroyed the five-story building at the corner of Broadway and Warren Street, and badly damaged the upper half of the Home Life Insurance Company's building, a modern steel structure, sixteen stories high, invaded the three upper floors of the Postal Telegraph Company's building. Beyond the burning out of a few window sashes and a slight damage by water the telegraph company's property was not affected. On Monday morning the telegraph service was conducted as usual. Some of the reports in the daily papers gave the impression that the Postal Telegraph Company and the Commercial Cable Company suffered considerable damage, but these were exaggerations.

TELEPHONES FOR THE FIRE-ALARM SERVICE.—The Fire Department contemplates the introduction of a telephone service in connection with the fire-alarm signal system. It is proposed to constitute every fire-alarm box an emergency telephone station, and instead of turning in the signals for second and third alarms and ambulance calls by telegraph, verbal messages to fire headquarters will be transmitted. According to Superintendent Blackwell, of the fire alarm telegraph bureau, each box will be provided with a telephone plug or switch. The scheme contemplates that every chief in the department shall carry in his wagon a case which will contain a complete telephone outfit. When the chief reaches a fire and finds that additional engines are necessary he connects his telephone outfit with the box and sends a signal by telegraph to indicate the use of the telephone. The operator at headquarters will then use the telephone and communicate with the chief at the scene of the fire. The simplicity and economy of the proposed system commends it to the fire commissioner. It is stated that each box can be equipped for the telephone service at a cost of 70 cents. Superintendent Blackwell has received instructions to equip the boxes as proposed.

THE RAPID TRANSIT PROBLEM.—Messrs. Edward M. Shepard and Albert B. Boardman, counsel of the Rapid Transit Railroad Commission, have submitted an opinion on the present difficulties of the board. President Alexander E. Orr has proposed a method of overcoming these difficulties, an explanation of which together with portions of the opinion of the counsel were given out on Saturday last by Mr. Delafield, secretary of the board. There is a general agreement that special legislation of some form will be necessary to enable the board to proceed with the tunnel scheme, the gist of the argument being as to whether such legislation as is desired will be constitutional. The counsel is of the opinion that there is no constitutional limitation upon the power of the County of New York to raise money to build a tunnel railroad, if authorized by appropriate legislation. President Orr in his explanation, states that the present situation with reference to the building of the tunnel railroad is brought about by the inability of the enlarged city of New York to borrow a sufficient sum of money to carry on the work in the manner required by the rapid transit statutes, and the commissioners have reached the conclusion that unless the powers of the board are enlarged by further legislation, it would be impossible now, or for many years to come, to proceed with the construction of the railroad. Two courses only appear to be open to the board in the prosecution of its work. These are a request for legislation making the rapid transit road an asset exclusively in the County of New York (Boroughs of Manhattan and the Bronx), and correspondingly making the debt incurred for its construction a charge exclusively upon the county, and a request for legislation enabling the Rapid Transit Board, in its discretion, and, if for any reason construction by the county is found to be impracticable, to frame and sell to private capitalists a charter for the road. The only resource which is available, it appears, or which will be available for many years to come, is the borrowing capacity of the County of New York. The Legislature could repeal the provision of the Greater New York Charter, making the rapid transit road an asset of and a charge upon the greater city, and restore the road to the position originally intended for it and approved by popular vote, as being an asset of and a charge solely upon the Boroughs of Manhattan and the Bronx. New York County could issue its bonds to provide for the cost of the road. There is reason for relieving the Boroughs of Brooklyn, Queens and Richmond of their share of the burden, just as there is reason why the Boroughs of Manhattan and the Bronx should exclusively own the corresponding asset. Municipal construction was authorized by popular vote of the Boroughs of Manhattan and the Bronx. There has never been a popular assent to such municipal construction by the Boroughs of Brooklyn, Queens or Richmond, and Mr. Orr stated it as his belief that it would never receive such assent. A bill to give the Rapid Transit Board the power to create and sell a franchise would be comparatively simple, he stated. Provisions of that character are already in the rapid transit law, and it will only be necessary for the new bill to permit the Rapid Transit Board to avail itself of those provisions, notwithstanding the vote for municipal construction. This alternative is not open to the board under the law as it stands. If recourse is to be had to private capital to build the railroad it may possibly be necessary to enter once more upon the long and expensive process of obtaining consents of property holders (or the substituted consent of the court) as well as the consent of the municipal authorities. Moreover, the adoption of this latter alternative would involve the abandonment of the entire plan of municipal construction and the relinquishment of the great benefit which would accrue to this county from the ownership of the road. Mr. Orr stated that he was opposed to it personally unless it shall prove impossible to obtain the needed relief in any other manner.

THE FINAL REPORT of the president to the board of directors of the Edison Electric Illuminating Company, of Brooklyn, which was presented on November 8, is an extremely interesting document. It gives the history of the company from its inception down to the recent date when it was absorbed by the Kings County Electric Light & Power Company. The company was incorporated on March 8, 1887. In that year electric lighting had already made some progress. Arc lighting had been introduced for street lighting in Brooklyn for several years, but incandescent lighting had not yet attained a footing in the city, nor generally elsewhere except in a few of the large cities. At the meeting of the directors on November 20, 1888, the executive committee was authorized to proceed with plans for the erection of a power station and begin the laying of conduits in the streets. Work on the Pearl Street station, which was the first one established by the company, was begun at the opening of the spring of 1889. This station had a capacity of 3600 horse-power, its equipment consisting of four boilers and engines, with eight dynamos and complete electrical apparatus therefor, for supplying electrical current for light and power throughout an underground system covering a radius of a mile about the station. This station forms a part of the present Pearl Street station, and at the time of its erection was thought to be almost a model one for the business. But with the new year, 1890, the company, under the inspiration of Mr. William S. Barstow, began to install a new arc light which was under the control of the user, and offered advantages over the old style arc light. During that year 590 arc lights were installed by the company as well as 156 horse-power of motors, while the incandescent lights were increased in number to 17,356. The stockholders then authorized an increase of stock to $1,500,000 and of $500,000 in bonds, with the proceeds of which two more engines were installed in the station with the accompanying dynamos and electrical apparatus, while a new district of service was formed. In the year 1891 a great increase of business and progress was made and the Lexington Avenue station was built and equipped. It was at this time that the company began paying dividends, beginning with July of that year, at the rate of 4 per cent. per annum. In 1892 the lines were extended into the Eastern District of the city, and a power station was erected in Gwinnett Street. This station was equipped with machinery of the latest design, and the wires were laid underground through the principal streets. At the close of the year the company had connected the equivalent of 75,450 16-cp lamps. The receipts warranted the increase of dividends to 5 per cent. The new Eastern District station was notable for the introduction of the Morrin or Climax vertical boilers and the triple-condensing upright engines. Extensions continued through 1893, and the capital stock was again increased by 1,000,000. The Pearl Street station was enlarged and equipped with the latest machinery,

and the Lexington Avenue plant was practically rebuilt. In 1894 the company entered the field of street lighting, which was a new one for a low-tension company. To supply the demand thus increased by the street-lighting service two more vertical engines of 1500 horse-power each were erected in the Pearl Street station. In 1895 the Citizens' Electric Illuminating Company was purchased, its entire capital stock of 5000 shares at $100 each being paid for at the rate of $175, or a total of $875,000. The Citizens' Company was a high-tension overhead-wire system, with a valuable franchise, covering all the city except those wards known as Eastern District wards, which were supplied by the Municipal Electric Light Company. To provide for the purchase of the Citizens' Company the capital stock of the Edison Company was increased $750,000 and the bonds by $500,000. The lamp connections had increased to an equivalent of 154,523 16-cp lamps, and the service, both public and commercial, had been vastly improved. The report then refers to the imposition of "very serious and unreasonable taxes" on its property by the city assessors in 1895, but through the efforts of its counsel a reduction of the assessment for personal tax from $1,070,000 to $375,000 was effected. This contest, the report states, has arisen each year since, but the interests of the company have been very successfully championed. The steps that led to the building of the Union Station at Bay Ridge, which was described and illustrated in THE ELECTRICAL WORLD of December 3, 1898, are recited by the president in his report. This station is represented to be the most advanced electric lighting station on the continent, and is, in the words of the president, "a monument to the genius as well as as the engineering ability of our general superintendent, Mr. William Slocum Barstow." The new station, the report states, is built on a scale likely to fully supply all the electric current needed for light and power within the city for many years. The recent negotiations and final consummation of the consolidation of the Edison Company and the Kings County Electric Light & Power Company are briefly reviewed, and in conclusion the report congratulates the directors on the character of the employees in the service of the company and compliments many of them by name for their ability and faithful devotion to the company's interests.

NEW ENGLAND NOTES.

MR. PERCY HODGES, late of the General Electric Company, is now associated with C. S. Knowles, Boston, in the railway department.

MR. J. HENRY HALLBERG, of Peabody, Mass., was united in marriage at Salem, Mass., November 16 to Miss Mary Ellen Daley, an accomplished young lady of that city. Our congratulations and best wishes attend the happy couple. Mr. Hallberg is well known through his connection with the Standard Thermometer & Electric Company, of Peabody. He is the designer of the Upton Midget enclosed arc lamp.

MR. JOHN S. KEENAN, of the Bibber-White Company, Boston, well known in electrical circles, has resumed active service with the company. Mr. Keenan has long been a member of the First Massachusetts Heavy Artillery, U. S. V., with the rank of lieutenant and quartermaster. At the outbreak of the war with Spain this regiment was the first to respond for active service, and Lieutenant Keenan has, of course, been with it. He was most heartily welcomed on his return to business.

THE K. & W. COMPANY, Pittsfield, Mass., has never been so busy as at the present time, and the increased facilities afforded in its new factory are genuinely appreciated, not only by the company, but also by the electrical trade generally, which accords to the specialties of this company exceptionally liberal recognition. The "Hardy" incandescent lamps continue to grow in popularity and demand, and the numerous repeat orders received are the best possible indorsement of them. Other specialties of the company, such as composite dynamo brushes, hanger boards, spark arresters and commutator compound, are also in great demand. First-class goods and first-class management always bring custom, and this is precisely what the K. & W. Company may honestly claim.

AN IMPROVEMENT IN ELECTRIC SMELTING APPARATUS.—A further detail in the system of heating metals by means of an arc crossing a hydrogen envelope in a liquid bath, the invention of Geo. D. Burton, has been covered in patent No. 615,136, issued November 29, 1898. This describes an arrangement for heating simultaneously two bars which it may be desired to weld or braze together. One piece, as usual, is connected to one terminal of the circuit, its end being immersed in the bath suitably connected with the positive pole of a direct-current source, the other piece being also immersed within the bath and brought sufficiently close to the one that the current passes to it and forms about it a gaseous envelope subject to the arc, heating the two simultaneously.

REPORT OF THE WEST END STREET RAILWAY COMPANY'S BUSINESS.—The Boston Elevated Railway Company, lessee of the West End Street Railway, has made its report of earnings and expenditures of the West End Company. The statement shows for the year ended September 30 a total surplus, after charges and dividends were deducted, of $214,077, compared with the surplus of $431,572 in 1897. The gross receipts were $9,179,096, against $8,719,031 last year; operating expenses, $6,566,584, against $6,213,708 last year; net earnings, $2,690,668, against $2,505,323 last year. During the year there were carried 181,321,295 passengers, an increase of over 9,000,000. The car miles run were 32,209,150, and the average number of persons employed was 5328. The annual meeting of the stockholders of the West End Street Railway Company was held at 101 Milk Street on November 22. President Samuel Little submitted a brief financial statement for the year ended September 30. The stockholders voted to amend the by-laws so as to take from the directors the power of appointing unnecessary operating officials, and also to take from them the power of acting upon and declaring dividends. The old board of directors was re-elected.

BUFFALO AND NIAGARA FALLS NOTES.

NIAGARA ELECTRIC POWER has been in use at the Curtiss malt house in Buffalo some days, and is reported to be entirely satisfactory to all concerned.

THE BUFFALO STREET RAILWAY COMPANY has just laid a long line of subways down Main and out Perry Streets for the accommodation of its feed wires.

THE CITY of North Tonawanda is engaged in exacting from the Niagara Power Company the payment of 2½ per cent. of its gross earnings to the city for the franchise it is seeking there. The company demurs, but will no doubt accept the terms. It is also insisted that less shall be charged for the current than is paid in Buffalo.

THE RAPID extension of the use of Niagara power for lighting Buffalo streets is a good deal handicapped by the lack of cable. As fast as that can be obtained for the conduits the street lights will be changed over to the Niagara system. So far the use of the Niagara current in this capacity has hardly passed the stage of experiment, though no serious hitch has been reported.

THE BUFFALO, TONAWANDA & NIAGARA FALLS trolley line, the oldest one connecting Buffalo and Tonawanda, and usually called the Smith line, is to give up its power house and use the current from Niagara Falls. The contract is made, and it is said that about $25 a horse-power is to be paid. It will be some time before the change can be made, as the unfinished transformer house will be needed. This will not be done till late next month.

INDIANA NOTES.

THE INDEPENDENT TELEPHONE COMPANY of Indianapolis will begin service on January 1, 1899.

THE PEOPLE of Richmond are rejoiced over the proposed line of electric railway to connect that city with Indianapolis. The right of way has been secured.

THE BOARD OF COUNTY COMMISSIONERS of Hancock County has granted Charles L. Henry a franchise to build an electric railroad from Greenfield to Indianapolis.

THE INDIANAPOLIS LONG-DISTANCE TELEPHONE COMPANY has contracted to extend its line to Nashville. This is the first company to penetrate the wilds of Brown County, the only county in Indiana without a railroad.

MR. NATHAN MORRIS and other Indianapolis capitalists are seeking a right of way for an electric railway along the public highway between Anderson and Ingalls, a distance of 12 miles. They say the line will then be continued to Indianapolis, 36 miles. The petition will be granted.

FARMERS of Indiana are generally supplied with telephone service. Their residences are connected with those of their neighbors and with country towns and cities. "I sat under my own vine and fig tree and received the election news," said an old farmer of Montgomery County. "More, I ordered my insurance renewed at 11 o'clock of the day of its expiration. Had I been compelled to make the trip to town I would have been without insurance for several hours," said he.

THE BOARD OF COUNTY COMMISSIONERS of Marion County, sitting at Indianapolis, are kept busy hearing applications from rival companies seeking right of way for electric railroads between Indianapolis and other cities of the State. The interest manifested in this particular indicate that the day is near at hand when nearly all the Indiana cities and towns of any importance will be connected by electric roads. The gas-belt line recently opened between Anderson and Alexandria is being operated with marked success, and a movement is on foot to connect all the cities in the gas belt and then build a connecting line to Indianapolis. There are also lines projected in northern and southern Indiana, and the year 1899 promises to be a red-letter year in the construction of electric railways in this State.

THE NATIONAL MUNICIPAL LEAGUE conference was held at Indianapolis, the first session beginning on November 30. Delegates were in attendance from various parts of the country. A special committee made a report on an ideal American municipal charter. On the subject of franchise grants the report reads as follows: "Careful constitutional provisions have been promulgated as to the method of granting franchises. That such franchises should only be granted for a limited period is a principle that has now received very general acceptance. The application of this principle is of peculiar importance in a country like the United States, where the legislative authority is restricted by the constitutional guarantees to vested rights. With us the grant of a valuable franchise for an indefinite period is, in fact, if not in law, irrevocable. The enormous value of such a franchise makes it practically impossible for a city to repurchase it without seriously impairing its finances. The end which the committee has had in view has been to make the franchise grant in the nature of a lease for a short term, at the expiration of which the city as lessor enters into possession. The limits of the lease have been fixed at twenty-one years, a term amply sufficient to offer all necessary inducement to private corporations." The document provides for compulsory public accounting of all grantees of franchises. The conference and the report of the committee is attracting wide attention. The various provisions of the report are especially interesting and of concern to managers of private corporations, such as electric street railays, water, light and gas companies.

WISCONSIN NOTES.

THE JANESVILLE TELEPHONE COMPANY was recently organized by a number of business men of that city, and a complete exchange is to be put in.

THE MILWAUKEE ELECTRIC RAILWAY & LIGHT COMPANY now has in active operation about 175 miles of electric road in Milwaukee and to its immediate suburbs. By the close of the present year the company will have expended for improvements, completed or arranged for, considerably over $1,000,000.

SOME TIME AGO the Wisconsin Telephone Company made application

to the city of Marshfield, Wis., for a franchise to build a long-distance line through the city. It was refused, but went ahead and put up poles, which were cut down under the mayor's orders. The company recently put poles up again, which have also been cut down.

BY THE TIME the Superior Rapid Transit Company, of West Superior, Wis., completes the work of replacing the present narrow-gauge railway system with the new standard gauge and rolling stock it will have expended about $350,000, this including the laying of the tracks, material, labor and new rolling stock. Cars now run from any point in Duluth to West Superior, and the new interstate service will be inaugurated in the near future.

St. Louis Notes.

THE BOARD OF PUBLIC IMPROVEMENTS will submit another lighting bill to the City Council next week if the city counselor decides that a measure similar to one formerly defeated can be reintroduced. The new bill is to provide for a five-year contract, and is to include public buildings.

THE PEOPLE'S RAILWAY COMPANY was granted an appeal to the Supreme Court this week. The appeal was made as a result of the decision rendered by Judge Wood in the case of L. M. Rumsey against the People's Railway Company. Judge Wood, in his decision, ordered a foreclosure sale of the company.

SUPERINTENDENT OF FIRE AND POLICE TELEGRAPH Silas J. Benedict opened bids for burying the city's wires, on Monday, November 28. Only two bids were received—the Southern Electrical Supply Company, $13,618, and the Western Electric Company, $14,190. The Standard Underground Company submitted an explanation as to why it did not bid. "The specifications are too arduous," it said. The bids will be submitted to the comptroller, who will award the contract to the lowest bidder.

Pacific Coast Notes.

THE FALLEK TELEPHONE & AUTOMATIC SWITCH COMPANY, of San Francisco, was recently incorporated, with a capital stock of $100,000. The directors of the company are A. K. Andriano, W. T. Hess, Jr., Nathan Fallek and I. Harris.

THE SOUTHERN CALIFORNIA POWER COMPANY, after vexatious delays of long duration, is ready to transmit electricity at 33,000 volts a distance of 80 miles to Los Angeles, Cal. This water-power plant, which cost $500,000, has been two years in building. This transmission is said to be the longest in the world. There are 3½ miles of tunnels through granite mountains and 2 miles of flumes. Water is turned into the four water-wheels, directly connected to the generators, at the pressure of 310 pounds to the square inch.

THE UNION IRON WORKS COMPANY, San Francisco, successfully launched the battleship "Wisconsin" on November 26. Electricity will be used to operate incandescent lamps, four large searchlights, two large turrets, the ammunition hoists and the powerful fan blowers for the elaborate ventilating system. It is understood that there will be eight generators, each operated by a Union Iron Works vertical compound engine, directly connected. Four of the generators will be built by the electric department of the Union Iron Works and the remaining four will be supplied by the General Electric Company, in connection with its contract to install the apparatus for electrical operation of the turrets. The "Wisconsin's" displacement is 11,525 tons; I. H. P., 10,000 at 120 r. p. m.; probable speed, 16½ knots. She has eighty auxiliary engines.

THE PELTON WATER WHEEL COMPANY, San Francisco, recently closed contracts to build the following: Two Pelton wheels direct connected to 180-kw generator, for Standard Consolidated Mining Company, Bodie, Cal.; Pelton wheel direct connected to dynamo for lighting mill of St. Gothard Mining Company, North Columbia, Cal.; a 3-foot Pelton wheel for driving electric lighting generator for the London & British Columbia Gold Fields Company, Ltd.; wheel and generator, direct connected, for lighting mill of the William Hamilton Manufacturing Company, Vancouver, B. C.; three Pelton wheels, for the mill and electric plant for Lyndhurst Gold Fields Company, Ltd.; three wheels for a mining plant in New South Wales, Australia; four Pelton wheels, 3000 feet of pipe, etc., for a sugar mill near Tepec, Mexico; wheel for driving sugar mill of Hakalau Plantation, Hawaiian Islands; 15-foot wheel, direct connected to 200-hp Rand compressor, for the Gaston Ridge Mining Company, Graniteville, Cal.

Canadian Notes.

MESSRS. NESBIT, GAULD AND DICKSON, of Hamilton, Ont., are applying to the Ontario Legislature for an act to incorporate the Hamilton & Caledonia Railway Company. The idea of the promoters is to build a line from the city of Hamilton to Caledonia, and to extend it to the village of Selkirk. It will be an electric railway if the project goes through.

THE LARGEST dynamo in Canada has just been installed in the new power house of the Ottawa Electric Company, near the suspension bridge at the Chaudiere Falls. It is of the Westinghouse type, with a capacity of some 10,000 lights. The machine is very massive, and weighs 23 tons, and is 15 feet in height. This dynamo will supply current for the lighting of the Parliament and departmental buildings of Ottawa.

THE ANSWER of the Cataract Power Company to the city of Hamilton, Ont., to the City Council's request to state a price for power, also statements showing the number of lights used by the city, their cost and the saving to be effected by a civic plant, has been handed in. It is figured out on the basis of expert report that the city can save $4000 a year and have its own plant all paid for within twenty years. The Cataract Power Company will be given until February 1 next to quote figures for power sufficient to operate a plant for 500 arc lights and 1000 incandescent lights. Meanwhile all information gathered by the special committee will be laid before the City Council.

THE SOUTH SHORE, at the Lachine Rapids, Quebec Province, will soon be able to boast of hydraulic works similar to those on the north shore of the rapids, which belong to the Lachine Hydraulic & Power Company. A company has been formed composed of Canadians and New York capitalists. Work is expected to begin next spring, the promoters of the company intending to study during the coming winter the effect of the frazil ice in the chutes of the Lachine Power Company dam. To obtain the required fall the new company will have to dam Isle du Diable to the mainland, at the head of the rapids, and lower, from the same island to Isle du Paquette.

THE TOWN CLERK of Niagara Falls, in a letter to the press, says that the amount of power developed at Niagara Falls, Ontario, is being misrepresented in the statement that 50,000 horse-power is now developed and available for use, and that there is no demand therefor. The facts are as follows: By an arrangement with the Niagara Falls, Park & River Railway two dynamos of 500 horse-power each are placed in position and driven by a water wheel in the railway company's pit. These two furnish 750 electrical horse-power at the distance of 1½ to 2 miles, where it is being utilized. Of the said amount 250 horse-power or more has already been contracted for by the Niagara Falls Electric Light & Power Company, 200 by the Carborundum Company, and 100 by the Carmelite Monastery, so there is actually a very small amount, if any, now for sale.

French Notes.

TRACTION ENGINES AND AUTOMOBILES.—There will be a traction engine and automobile show next year at Ghent in connection with the Provincial Fair. Traction machines will very likely replace horses in the propelling of life-saving machines—fire engines, ladders, reels, fire-escapes, etc.—and they must be built so as to be able to start at a moment's notice. Also the cost of energy for operation must not be excessive. The competition will comprise two classes, one for vehicles having a load capacity of 5500 pounds over and above their own weight, the other having a load capacity of 11,000 pounds. A speed of 12 miles per hour on a level and 2½ miles per hour on an 8 per cent. grade, under full load, will be required. The machines which are exhibited will be put through a series of thorough tests, and the results will be published in detail. This is the first competition of its kind to take place in Belgium.

NATIONAL CONSERVATORY OF ARTS AND CRAFTS.—During 1898-99 the free lecture courses at the National Conservatory of Arts and Crafts will include a course in applied physics, to be conducted by Prof. M. J. Viole, who will treat the following subjects under the head of electricity: Fundamental laws of electrical and magnetic phenomena; measuring instruments; generators, accumulators and transformers; transmission of power; telegraphy; telephony; electrical oscillation; lighting, and electroplating. Prof. M. Marcel Deprez will also lecture on industrial electricity, covering the following subjects: Study of the fundamental laws of electricity considered from the point of view of their industrial applications; laws governing the transmission of electrical energy in all its forms; instruments for measuring electrical quantities; general theory of generating machinery for the conversion of mechanical energy into electrical energy, and vice versa.

ELECTRIC TRACTION IN PARIS.—Tuesday, October 8, saw the completion of the first 2-cent fare electric tramway line of Paris. The Southern Tramways Company or Paris Tramway Company is now operating its Bastille-Charenton line partly by overhead trolley and partly by underground trolley, which was permitted as an experiment by the Municipal Council acting in accord with the General Council of the Seine. Judging from the simplicity and good appearance of the whole construction, there is ground for hoping that the company will soon see its way to changing over its other lines, to the great benefit of the public. Travel will be much more rapid, and the great number of cars which it becomes possible to operate will reduce the time spent in waiting. Moreover, the poles which support the wires can be used in the poorly lighted suburban districts as arc light standards. The Avenue Daumesnil presents a good object lesson in the advantages of the new system. All the construction work on this line has been carried through by the French Thomson-Houston Company.

ELECTRICITY IN THE NAVY.—The Minister of the Navy has established a new branch of the service, to consist of officers specially educated in electricity. These men will be drawn from among the non-commissioned officers who graduate from the torpedo service school at Toulon, and who make application for the position, due regard being paid to their relative standing at the time of graduation. The officers selected will take the course given at the Advanced School of Electricity of Paris, and will be required to pass a special examination. The successful candidates will be eligible to the following appointments: First, when a sufficient number have been graduated to permit it, there will be the position of electrical officer on board all war ships having much electrical apparatus. Second, electrical officer attached to newly-built vessels under equipment. These officers will be carried on the department of harbor defense. Third, each of the five seaports will furnish a position as adjutant to the director of the submarine defenses; the incumbent will have charge of special experiments involving the use of electricity, will serve on the commissions appointed to test new ships and will superintend the lighting plant of the arsenal, etc. Fourth, there will be positions in the central torpedo and electrical service at Paris. Fifth, a position as adjutant to the vice-admiral presiding over the board of works. The last two positions will be open only to officers who have already held positions in their special line of work, excepting where they are appointed to a command or are detailed on special duty. These officers can be appointed only to electrical duties.

ELECTRICITY APPLIED TO TRAINS.—The Orleans Railway Company sent a body of engineers to America last spring to study the applications of electricity in hauling heavy trains, with a view to introducing something similar on the new line between the Place Walhubert and the Quai d'Orsay at Paris. On their return these gentlemen gave out for publication the following conclusions: "Although the applications of electricity to heavy traction are not yet very numerous in the United States, existing plants demonstrate con-

clusively that there are no technical difficulties to prevent its use over relatively short distances. Existing stations are producing enormous volumes of electrical energy for railway purposes at very reasonable costs. There are numerous cases of feeders carrying loads quite equal to anything which would be required for a heavy train service, and notably at Buffalo there is a case of transmission of energy over a distance of 22 miles. The practicability of the method of taking current from a continuous conductor, either overhead or on the ground, by means of a sliding contact, is well proven. The elevated railway of Chicago (trains weighing 108 tons and running on two-minute headway) uses a third rail, supported on paraffined wooden blocks, showing that the third rail is all-sufficient for power distribution to trains under the most crowded conditions. Finally, the electric traction machine, whether a locomotive or car fitted with its own motors, has been evolved to standard conditions; motors, and especially controlling apparatus, are built to work under volumes of power greatly in excess of anything needed in the heaviest service in France."

THE HEILMANN LOCOMOTIVE ON THE PARIS-HAVRE LINE.—The Heilmann locomotive recently made the trip from Mantes to Rouen. As is generally known this machine is in two parts, each half being carried on bogy trucks with eight wheels, and each axle being driven by a motor, thus utilizing to the utmost the weight of the machine for traction. It is this arrangement which enables this monster, measuring 60 feet over all and weighing 120 tons, to circulate on the existing railways. One would be tempted to think that such a machine, weighing nearly 40 tons more than the modern locomotive with its tender, would make much more noise than the latter does. The fact, however, is that to anyone riding on it the engine seems to move with a sliding motion; there is no shock perceptible; hardly even a slight vibration. The great weight does, however, shake the ground over which it travels to a depth of nearly 10 feet, and the object of this trip was not a speed test, which was made last winter, when a speed of 75 miles per hour was attained, but a test of the steel bridges and trestles on the line. Every bridge was furnished with a recording deflection indicator, and the engine was stopped when at the further side of the bridge to observe the record made by its passage. The engineers of the Western Company were greatly pleased with the results, which showed no abnormal deflections. Many comments have been made on the peculiar shape of the engine. The rear view differs but little from that of an ordinary engine, but the front view presents the appearance of an armored cruiser or a torpedo boat, armed with a ram, mounted on wheels. The engine-driver stands in this part in front of two large port holes from which he can observe the track. The starting mechanism requires no exertion, a couple of turns of a small vertical hand-wheel and the great engine starts easily and without shock. The use of electricity as a connecting link between the engine and the driving wheels eliminates that vibration and pounding of the ordinary engine, which is so destructive of the track as well as unpleasant to the passengers.

General News.

THE TELEGRAPH AND TELEPHONE.

BRISTOL, PA.—The Standard Telephone Company has been granted a franchise to construct and operate a telephone system in the Borough of Bristol.

GALVA, ILL.—The Galva Telephone Company has already 109 'phones put in. Indications are that 150 'phones will be in operation before many months.

ELMIRA, N. Y.—The New York & Pennsylvania Telephone & Telegraph Company is building a metallic circuit line from Towanda to Wyalusing to take the place of the present line.

LYONS, N. Y.—The Wayne County Telephone Exchange has begun to set poles in Lyons. It is expected that the exchange here will be in complete operation by the middle of December.

ONEONTA, ALA.—The new telephone line between Opelika and Lafayette, Ala., has been finished, thus completing the network of wires that run from Opelika in every direction, except to Birmingham.

McKEESPORT, PA.—The new combined telephone and telegraph service of the Baltimore & Ohio Railroad from Baltimore to Newark, Ohio, via the Pittsburg division, has been tested, and the system works satisfactorily.

TERRE HAUTE, IND.—The Citizens' New Independent Telephone line has opened for business, having connections with a large number of places north of here, in Indiana and Illinois. As yet there is no city exchange.

NAZARETH, PA.—The Slate Belt Telephone & Telegraph Company has commenced the reconstruction of its lines as metallic circuits. Over $10,000 will be expended in construction, and new switchboards will be put in at Nazareth, Bangor, Pen Argyl and Wind Gap, Pa.

TRENTON, N. J.—The Delaware Shore Telephone Company has been incorporated with a capital stock of $15,000. The incorporators are Mitchell B. Perkins, of Beverly; Nathan Haines, J. Howard Pugh, George C. Gunn, of Burlington, and Harry V. Massey, of Philadelphia.

NEW YORK, N. Y.—Some of the retail druggists in the Boroughs of Manhattan and Brooklyn, in whose stores are public telephone stations, are, it is reported, threatening to discontinue the maintenance of such stations because of the reduction of their percentage of the receipts.

RENOVO, PA.—Renovo's Council has adopted the ordinance which gives the Central Pennsylvania Telephone Company the right to construct its lines within the limits of the borough. An effort was made to impose a tax on the poles of the company, but this amendment was defeated.

NEW YORK, N. Y.—It is stated that the People's Telephone Corporation, the new independent company that is now canvassing for subscribers, secured 5000 subscribers the first few days of its work, and expects to secure 40,000 by February 1. It is expected that the company will begin active operations at that time.

BALTIMORE, MD.—An ordinance has been prepared for the repeal of the ordinance granting to the Cheasapeake & Potomac Telephone Company a franchise for laying conduits in the streets of the city. These new developments will place the telephone company in rather an awkward fix, and has put a stop to its work on conduits.

CHICAGO, ILL.—A company, in which Armour, Swift and Nelson Morris are interested, has been incorporated to build and operate an independent telegraph and telephone line to connect all of their packing houses in the West with their Chicago houses. The proposed line is to connect East St. Louis, Omaha, Sioux City, St. Joseph and Kansas City.

COLUMBUS, OHIO.—The new telephone company which is being organized in this city upon a new plan and which partakes largely of the co-operative plan will ask for franchises over the streets and alleys of the city for its wires. With the new company every subscriber is a stockholder and will have a voice in the management of the affairs of the company. The capital stock will probably be $100,000.

TOLEDO, IA.—The Commercial Telephone Company, operating exchanges here and at Tama and having toll lines to Crystal and Traer, with stations at several farm houses, has sold out to W. D. Spayth & Co. The officers of the new concern are: W. D. Spayth, general manager; W. H. Withington, president; H. C. Shanklin, treasurer; E. M. Spayth, secretary; W. H. Withington, A. G. Smith, W. D. Spayth, J. G. Bull and J. R. Caldwell, directors.

SHAMOKIN, PA.—The North & West Branch Telephone Company has decided to construct a line connecting Williamsport, Montgomery and Montoursville with the local line. The contract was awarded to W. D. Bernard, of the East Telephone Construction Company, work to be commenced within thirty days. The directors state that next spring a telephone line will be constructed between Danville and Bloomsburg to be connected with the local line.

LITTLE ROCK, ARK.—On the evening of November 27 a test was made of the long-distance telephone circuit between this city and Boston, a distance of about 1900 miles. Mr. Charles J. Glidden, president of the Southwestern Telegraph & Telephone Company, sat at the instrument at this end and conversed with Mr. Frederick A. Farrar at Boston. It is stated that the conversation was perfectly clear and distinct. Long-distance service tests were also made with other cities.

BOSTON, MASS.—The severe snowstorm of November 26-27 caused a great deal of damage to telegraph and telephone lines in this section. The New England Telephone & Telegraph Company's service was somewhat impaired in the suburban districts, where its wires are overhead. In the city there was no trouble, as the circuits are all underground. The long-distance service was also affected somewhat, about one-half the number of its wires being unavailable. The Postal Telegraph Company had no wires to New York on Monday morning. In fact, it had few wires in any direction for any great distance. The Western Union Telegraph Company accepted business to New York and distant points, subject to short delays. It had no wires to give to its wire lessees.

ELECTRIC LIGHT AND POWER.

PIERRE, S. D.—The City Council at a special meeting decided to put in an electric light plant for the city, to be supplied with power from the gas well.

HAGERSTOWN, MD.—The Mayor and Council are still undecided whether to erect a municipal electric light plant or continue the present contract with the local company.

OCONTO, WIS.—The electric light plant on the People's Light & Manufacturing Company was destroyed by fire on November 24. The loss is placed at $35,000; insurance, $14,000.

ATTICA, N. Y.—The plant of the Attica Electric Light Company has been sold to Mr. Ulmer, of Buffalo, for a consideration of $2800. The wire and poles are being taken down and shipped to Buffalo.

PONTIAC, ILL.—Judge R. R. Wallace was appointed receiver of the Pontiac Water, Light & Power Company's plant in this city upon the application of the Illinois Trust & Savings Bank of Chicago, trustee for the holders of $49,000 in bonds, which were issued upon the plant in a foreclosure suit.

BUFFALO, N. Y.—The first step has been taken by the Buffalo General Electric Company toward lighting the streets of Buffalo with power generated at Niagara Falls. A circuit of 450 arc lights, including the double-light system on Main Street, from the docks to Virginia Street, is now operated by Niagara power transformers, and the whole system will be in operation before next summer.

ALBANY, N. Y.—The Valley Electric Light Company has been incorporated with a capital stock of $10,000. The company is to furnish light in Lansingburg, Melrose, Schaghticoke, Stillwater, Valley Falls, Johnsonville, Buskirk's Bridge and Eagle Bridge. The directors are Edward O'Neil, Hiland Carpenter and Augusta Carpenter, of Valley Falls, and Jonathan N. Carpenter, of Hoosick Falls.

NEW YORK, N. Y.—Naval Constructor Bowles at the Brooklyn Navy Yard has recommended certain changes to be made in the yard with the idea of facilitating the work of the various departments. He proposes a system of trolleys for the handling of boats and supplies, and also for the purpose of distributing the 6-inch and smaller guns among the vessels in the yard. It is estimated that the changes will cost $50,000.

FREDERICKSBURG, VA.—At a meeting of the City Council a resolution was passed for the erection of an electric light plant at an approximate cost of $11,600, and ordering an election for the ratification or rejection by the voters of the city. No contract will be awarded until the election is held, but the bids received by the light committee were read as follows: Kingsbury, Samuels & Co., of Baltimore, Md., $11,944; the Fort Wayne Electric Corporation, of Fort Wayne, Ind., $11,649.

PHILADELPHIA, PA.—It is reported that the Pennsylvania Manufacturing Company has purchased the electric lighting plants of Camden and Atlantic

City in addition to like properties in New York and this State. The aggregate capital of the acquired companies is placed at nearly $2,000,000. The transactions involved the payment of cash by the Pennsylvania Manufacturing Company. It is said the securities of the purchased properties, against which no new securities are to be issued, will be placed in the treasury of the Pennsylvania Manufacturing Company as treasury assets.

DURHAM, N. C.—The Durham Electric Lighting Company is preparing to install a 60-kw Westinghouse alternator. The present equipment consists of a 15-kw arc machine and a 750-light alternator, the former being run by a 60-hp engine and the latter by one of 90 horse-power. The contemplated improvements in the plant will give better service and a capacity of about 1700 or 1800 incandescent lights, as against 700 at the present time. There are forty-six arcs on the Thomson-Houston system, for which $100 a year each is paid, operating on moonlight schedule.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Easton, Pa., is preparing to extend its plant, and will probably use water power from the Lehigh River as an auxiliary to its present steam plant. It is also further considering the purchase of a direct-connected unit of 400 horse-power. This plant has always been able to produce current at a very low cost, but the company believes that by further improvement it can reduce the cost still more. Mr. Albert B. Herrick, the company's consulting electrical engineer, is preparing the plans of these improvements.

BALTIMORE, MD.—The consolidation of the three electric light companies of Baltimore will be consummated by January 1. "The Consolidated Electric Light Company" is the name of the new corporation, which absorbs the Brush Electric Light Company, the Edison Electric Company and the Northern Electric Light Company. The consolidation is being conducted by E. B. Smith & Co., of Philadelphia, and the Baltimore Trust & Guarantee Company. It will issue $4,000,000 5 per cent. gold bonds and $5,000,000 in stock. All the bonds and a majority of the stock have been subscribed for.

CHICAGO, ILL.—Armour & Co. will change the motive power at their packing house from steam to electricity. It is estimated that the work will take nearly a year on account of the necessity of making the change without interfering with the regular business. Work will soon begin on the power house, and some of the engines and dynamos have already been purchased. The works have already been wired for 5000 lights. There will be installed as soon as possible one 5000 and two 3000 light alternators, and more may be purchased. A cross-compound Corliss engine of 1700 horse-power is all ready for installation, and two power generators of 2400 horse-power are also ready. It is thought that the economy effected by the concentration of the power-generating system under one roof will be considerable.

THE ELECTRIC RAILWAY.

PHILADELPHIA, PA.—The Central Electric Railway Company, of Philadelphia, and Delaware County, has voted for an extension of its route.

FREDERICK, MD.—An extension of the Frederick, Middletown & Myersville Electric Railway from Myersville to Hagerstown, 10 miles, is contemplated.

LAUREL, MD.—It is stated that a preliminary survey will be made for an electric railroad to run from Laurel to Frederick, and also for one from Ellicott City to Rockville.

WILLIMANTIC, CONN.—The Willimantic Street Railway Company has been incorporated. The capital stock is $1000. The stockholders are Eugene S. Boss, J. Griffin Martin and Solomon Lucas.

PHILADELPHIA, PA.—Next month $20,000 more of the Continental Passenger Railway Company's bonds—6 per cent.—mature and will be retired, saving the Union Traction Company $1200 in interest. The process is going on throughout the system.

NEW YORK, N. Y.—The Brooklyn Heights Railroad Company has ordered 150 new open cars to be delivered next spring. They are to be built by the St. Louis Car Company, and will be 36 feet long, with thirteen reversible benches, having a seating capacity of seventy-five.

CUMBERLAND, MD.—The survey is being made for the electric railway to be built from Cumberland to Westernport, a distance of 30 miles. Messrs. Isaac A. Walker & Son, of Philadelphia, have secured the contract, and work will be commenced not later than March 1.

RUTLAND, VT.—The bill consolidating the Bennington Electric Railway Company and the Hoosick Electric Railway Company has passed both branches of the Legislature. The total length of the two roads, which have been practically consolidated for some time, is 16½ miles.

HULL, QUE.—The question of extending the Hull & Aylmer Electric Railway to Gatineau Point is under consideration. It is the intention to commence the construction next spring. At the last meeting of the City Council it was decided to call for tenders at once for the lighting of the city by electricity.

BALTIMORE, MD.—The negotiations for a union of the Baltimore Consolidated Railway Company and the Baltimore City Passenger Railway Company are in statu quo. The representatives of the companies have been unable to agree upon terms, and there are other obstacles to a union to overcome which will require tedious work.

FALL RIVER, MASS.—The Globe Street Railway Company, of Fall River, divided $400 in gold a few days ago among twenty-six conductors and motormen who have been freest from accidents and complaints and made the best records in the service during the last year. The distribution is an annual event of much importance to the employees.

RICHMOND, VA.—Great interest is being manifested in what will become of the valuable street railway franchises now held by the Richmond Railway & Electric Company when the time for which they were granted to that corporation expires. It is stated that a number of companies have been formed for the purpose of bidding for these franchises, which expire at different dates.

COLUMBUS, OHIO.—Judge Taft, of the United States Circuit Court, has ordered the sale of the Zanesville electric railroad on January 8, 1899, at the company's office in that city. Will Christy was appointed special master to make the sale. Suit was brought by the International Trust Company of Massachusetts on account of a default in interest. Over $800,000 principal and interest is due.

BARABOO, WIS.—The City Council granted a franchise to the Baraboo, Kilbourn & Devil's Lake Electric Railway Company to use a street in this city. The line will cover a distance of 18 miles, and the work will commence early in the spring. The road will connect two of the most popular summer resorts in the State. The incorporators are J. P. Cottrell, of Milwaukee; F. J. Butler, California, and H. Grotophorst, of this city.

WASHINGTON, D. C.—The work of equipping the Eckington street railroad, now the City & Suburban, with the underground electric system has begun. For the present the work will not go farther west than Fifth and G Streets, as it is the intention not to tear up G Street until all the iron work is on hand. When the New York Avenue line is finished then work will begin on the lines running through the eastern portion of the city.

LAWRENCEBURG, IND.—The Cincinnati, Lawrenceburg & Aurora Electric Street Railway Company has been incorporated with a capital stock of $10,000. The principal office of the company is in Lawrenceburg. The road begins at Aurora and extends from that point through Dearborn County to Lawrenceburg, thence to Cincinnati. Among the directors of the new company are J. C. Hoover, George H. Helvey and C. E. Hooven, all of Hamilton.

PITTSBURG, PA.—A daily paper of this city makes this pertinent remark: The proposition in Allegheny councils to make every street car carry a lifting jack for raising the car when people get under it appears to be highly proper if the present arrangements for getting people under the cars are to continue. But is it not a little more urgent to make them carry fenders that will give people, struck by the cars, a better chance to escape being thrown under them?

SOUTH BEND, IND.—A new street car service has been inaugurated in this city after a suspension of service for over four months. The lines have been entirely rebuilt at an expense of nearly $200,000, and the equipment is modern. Work will begin as soon as the weather will permit on lines connecting South Bend with Niles, Mich., and Goshen and Elkhart, Ind., making, with the present lines, 46 miles of electric street railway. The present city and suburban line cover 15 miles.

WASHINGTON, D. C.—The Belt Railway in Washington, with its franchises and property of different kinds, has been sold to Mr. Oscar T. Crosby for $350,000. Mr. Crosby represented the City & Suburban Company, of Washington, in which several Baltimoreans are interested. The Belt Company is the designation of the chain of roads acquired in Washington by the syndicate headed by Mr. Searles in connection with the old Beauregard line between Baltimore and Washington.

PETERSBURG, VA.—A deed of sale from the Petersburg Railroad Company to the Richmond & Petersburg Railroad Company has been recorded. In consideration of $1,952,072.50 the company conveys to the Richmond & Petersburg Railroad Company all of its real and personal property. The object of this deed is to carry out the provisions of the act of the General Assembly approved March 1, 1898. This deed has upon it $2000 of United States Internal Revenue stamps, and the State tax on it was $1970.

CHICAGO, ILL.—A vote taken in the City Council on the city railways' proposition to make permanent the trolley system, which it was recently permitted to operate temporarily in the business district, was defeated by a vote of 40 to 22. As this vote was considered a test of the street railway combination's strength, and as the next Legislature will favor the repeal of the Allen bill, it will be seen that the companies must do quick work in order to have their franchises extended for fifty years before the bill permitting the extensions is repealed. The franchises will all expire within a year or two.

WASHINGTON, D. C.—The request from the Washington, Arlington & Falls Church Railway Company, which has its northern terminus at the Virginia end of the Aqueduct Bridge, that the commissioners recommend that Congress grant permission for the construction of a single track across the bridge, has been denied by the District commissioners. The object of the railway company in seeking such construction is to have an outlet for its road to the city. At present the road extends only as far as the lower end of the Aqueduct Bridge, and the passengers have to cross the bridge by foot or in coaches.

NEW YORK, N. Y.—Fire in the Borough of the Bronx on the afternoon of November 30 destroyed the car shed and seventy-five cars of the Union Railway Company. The building was two stories high and on the second floor were stored sixty open summer cars and fifteen new closed cars, the latter of which had never been used. The fire started about noon, and difficulty was encountered by the fire department in reaching the scene on account of the snowdrifts in the streets. The entire loss to the railway company is estimated at about $150,000. Of this amount $25,000 represents the value of the building. It is stated that there is an insurance of about $100,000 on the property destroyed..

ALBANY, N. Y.—The Buffalo Traction Company filed its report for the quarter ending on September 30 with the Railroad Commissioners. It shows: Gross earnings, $13,739.63; operating expenses, $21,728.83; deficit, $7989.20; fixed charges, $11,576.12; total deficit, $19,565.32. Assets, cost of road, $1,372,804.92; cash, $1,109.84. Profit and loss, deficiency, $62,715.71. Liabilities, capital stock, common, $515,100; funded debt, $858,000.

CHICAGO, ILL.—It is stated that a syndicate of New York capitalists is being organized in that city for the purpose of acquiring the traction franchises from the city of Chicago. The report was that this company would offer to pay 20 per cent. of the gross earnings of all lines, improve the streets in which the tracks run and maintain them for the life of the franchise, which was to be put at fifty years. The proposition was to be based on the failure of the present traction corporations to have passed satisfactory ordinances, and the consequent obligation of the municipality to purchase under arbitrators' award

the rolling stock, trackage and other equipment of the three roads at a price to be determined. The city would then sell or lease this property to the new lessees of the streets, following the plan of purchase and lease which was adopted by the City Council of Toronto, Ont.

LEGAL NOTE.

A YOUNG WOMAN teacher of vocal music at Elwood, Ind., has sued the Elwood Electric Railway Company for $20,000 damages. She alleges in her complaint that while driving on the streets of that city her horse became frightened at a car, and she was thrown from the buggy, breaking her lower jaw and knocking out her front teeth, in consequence of which injury she cannot sing any more and is compelled to give up her vocation. Whatever may be the equities of her cause it is clear she cannot recover, as the Supreme Court of Indiana recently decided that people who will drive along a street containing a street car line take the risk of their horses becoming frightened at the cars. The operators are not bound to stop a car because a horse shows signs of fear or nervousness at its approach. People riding in cars have a right to proceed as well as those riding in buggies. (So held in Yant v. Terre Haute Street Car Co.)

PERSONAL NOTE.

MR. FREDERIC SAXELBY, well known throughout the electrical trade, and who was recently connected with the Siemens & Halske Electric Company, has allied himself with the Bullock Electric Company, and will now handle this company's apparatus from its New York office in the St. Paul Building.

Trade and Industrial Notes.

THE OTTO GAS ENGINE WORKS announces that it has received a gold medal award at the Omaha Exposition for Otto gas and gasoline engines.

THE FIRM of W. C. Nagel & Co. has been organized at Toledo, Ohio, for the purpose of conducting a general business in electrical machinery, supplies and construction.

THE B. F. STURTEVANT COMPANY, Boston, Mass., has just issued a second edition of its pamphlet Bulletin E, entitled "Draft Without a Chimney." A copy will be mailed to anyone on application.

THE ELECTRIC APPLIANCE COMPANY reports that it is meeting with much success with the 1898 model Packard transformer, and that this transformer is more than fulfilling all the claims and guarantees that they have made.

MESSRS. MEYSENBURG & BADT, Chicago, report a large increase in their sales of Weston instruments during the month of November. They remind Weston clients of the fact that several days' time may be saved by addressing to them inquiries concerning these instruments.

THE INTERNATIONAL FACSIMILEGRAPH COMPANY has been incorporated at Cleveland, Ohio, by W. P. Dunlany, Thomas Mills, H. F. Fulton, A. S. Taylor and W. H. Dettelbach, with a capital stock of $25,000. The company will manufacture apparatus for transmitting pictures by electricity.

STURTEVANT GENERATING SETS.—The B. F. Sturtevant Company, Boston, Mass., in its Bulletin G, just issued, gives illustrations and points out the principal constructional features of its line of generating sets direct coupled to automatic horizontal and upright engines. Some interesting combinations are shown.

MR. C. F. CROSELMIRE, of Newark, N. J., refiner of crude platinum ore, is now in Europe for the purpose of making contracts with Russian mine owners for platinum ore. In addition to refining crude ores, Mr. Croselmire is a manufacturer, on an extensive scale, of platinum products used in the electrical industries and arts.

THE OSBURN ELECTRIC MANUFACTURING COMPANY, of 294-296 Dearborn Street, Chicago, has evidently struck a popular article of manufacture in its tripolar bell. This company writes that it cannot keep up with its orders in this line, and is compelled to add more machinery to its plant. It also reports an export order for 10,000 tripolar bells.

THE BALL ENGINE COMPANY, of Erie, Pa., supplied the 125-hp tandem compound engine installed in the electric light plant of the city of Elkhorn. This power plant was recently successfully started. The Schoenhoffen Brewing Company, Chicago, has recently installed a 100-hp engine built by the Ball Company. This engine is direct connected to a 60-kw Western Electric generator.

THE AKRON INSULATOR & MARBLE COMPANY, Akron, Ohio, has lately begun to manufacture a full line of white porcelain goods, and is now enjoying a very large trade in porcelain specialties. This firm is well equipped to manufacture all kinds of special work, and the fact that it is very busy in this department indicates that the merits of its new electrical devices are being recognized by the trade. This company claims to be the pioneer manufacturer of light and brown glazed-clay thin-wall wiring tubes, etc.

ELEVATOR COMBINATION.—A certificate of incorporation of the Otis Elevator Company was filed at Trenton, N. J., on November 28. This concern is said to be an expansion of the National Elevator Company, which included Otis Brothers & Co., the Crane Elevator Company and the Hale Company, of Chicago; the Whittier Company, of Boston, and Stokes & Parrish, of Philadelphia. It is reported that the combination will have no control over the business of the Sprague Electric Company, but will probably pay the company a royalty for the use of its patents.

THE CINCINNATI MILLING MACHINE COMPANY, Cincinnati, Ohio, has issued a very complete and well illustrated catalogue of its Universal cutter and tool grinder. Various improvements are embodied in this machine, and its special features are set forth and illustrated. The catalogue includes a long list of testimonials from various concerns using the Universal cutter and grinder, all of which speak of the machine in the highest terms. Illustrated examples of the work done on the machine shows that the word "Universal" is well applied, for its great variety is rather surprising.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, on November 23 dedicated its new large two-story building by an entertainment to its employees, 128 in number. President T. H. Gillmer, in a few remarks, stated that the company was organized November 19, 1892, and had at the time very few employees on its pay roll. It now has 128 persons in its service. A nice supper was provided, after which the evening was spent in dancing. The utmost good feeling seems to exist between employer and employee as regards this company.

MESSRS. WARREN WEBSTER & CO., Camden, N. J., are out with a new circular on the Webster system of steam heating. It contains a story written by the late Edgar W. Nye, and illustrated by various thumb-nail sketches which are quite apropos. The story describes the nocturnal experience of a hotel guest with the radiator in his room, and the moral is that his slumbers would not have been disturbed had the hotel been fitted with the Webster system. A full-page illustration contains views of various large office buildings which are heated by the Webster system.

THE EUREKA TEMPERED COPPER COMPANY, North East, Pa., announces that it is now engaged in the preparation of one of the most complete and expensive catalogues ever issued by any concern in this line of business. The catalogue will be ready for distribution in the near future, and anyone using tempered copper would do well to write to the company for a copy. The company states that it is extremely busy not only in the filling of domestic orders but for goods to go abroad. Mr. Alfred Short, of this company, who is abroad looking after its interests, will soon return to the United States.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is furnishing motors for small power uses ranging from one-thirtieth to 3 horse-power. A typographical error in THE ELECTRICAL WORLD of November 26 in an item on this subject made the range of powers from one-thirtieth to 30 horse-power. The company is not prepared to handle such heavy power; it, however, calls attention to the fact that it has over 100 kinds of motors adapted for small power purposes. Few electrical stations and dealers pay as much attention to the interests of small power users as the importance of the subject warrants.

WHAT PROMISES to be a very interesting as well as a very novel electric power transmission system is now being installed by the C & C Electric Company upon Riker's Island at the entrance to Long Island Sound, opposite Manhattan, for the R. H. Hood Company, of New York. The Hood Company has the contract for the removal of ashes and similar refuse from Manhattan, which will be used for the purpose of filling up Riker's Island. The ashes will be transferred in scows to the island, where they will be unloaded upon conveying belts and distributed by electric power. The C & C Electric Company will furnish two 250-volt belt-type generators, each of a capacity of 120 kilowatts at 525 revolutions, together with the necessary switchboard. The motor equipment will consist of a 50-hp multipolar and a 40-hp, a 20-hp and a 10-hp closed-type ironclad motors. Two of these ironclads will be fitted with back gears for driving the conveyors.

THE S. K. C. INDUCTOR ALTERNATOR, illustrated in Bulletin No. 12,001, recently issued by the Western Electric Company, Chicago, represents the latest development in alternating current apparatus. These generators are manufactured for single, two and three-phase currents and for high or low voltage. The standard belt-driven generators are made for 7200, 8000 or 16,000 alternations, from 50 kilowatts up to 750 kilowatts. Direct-connected machines are regularly built from 250 kilowatts to 1000 kilowatts. The smaller machines are wound from 1200 volts to 6600 volts, and the larger from 1200 to 12,000 volts. The Western Electric Company is the exclusive Western agent for all apparatus manufactured by the Stanley Electric Manufacturing Company. In addition to supplying apparatus this company installs power transmission plants, and erect all pole lines and circuits complete in every detail. A copy of Bulletin No. 12,001 will, on application, be mailed to anyone who has not been supplied.

THE RIDGWAY DYNAMO & ENGINE COMPANY, Ridgway, Pa., reports the following recent sales of machinery: To the Berwind-White Coal Mining Company, Windber, Pa., one 75-hp engine, direct connected to a 50-kw generator; Alpena Sulphite Fibre Company, Alpena, Mich., one 32-hp engine, direct-connected to a 20-kw generator; Nashville Abattoir, Hide & Melting Association, Nashville, Tenn., one 50-hp engine, direct connected to a 30-kw generator; the Newtown Electric Railway Company, Newtown, Pa., one 450 and one 225-hp engine; the Fred W. Wolfe Company, Chicago, Ill., one 125-hp engine, direct connected to a 75-kw generator; Buffalo Hospital, one 125-hp engine, direct connected to a 75-kw generator; Worcester (Mass.) County Court House, one 85-hp engine, direct connected to a 50-kw generator; F. Bissell & Co., Toledo, Ohio, one 85-hp engine; Clarksdale Water & Light Company, Clarksdale, Miss., one 85-hp engine; Lake Lighting Company, Hammond, Ind., one 370-hp engine; United Gas Improvement Company, Philadelphia, three 60-kw direct-connected generators; William M. Barker, Deadwood, S. Dak., one 30-kw belted generator; Model Mill Company, Nashville, Tenn., one 20-kw belted generator; Gregory Central Station Company, Chicago, Ill., two 60-kw belted generators; University of Tennessee, Knoxville, Tenn., one 30-kw direct-connected generator.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

PATENTS
ILLUSTRATED RECORD OF ELECTRICAL

UNITED STATES PATENTS ISSUED NOVEMBER 29, 1898.

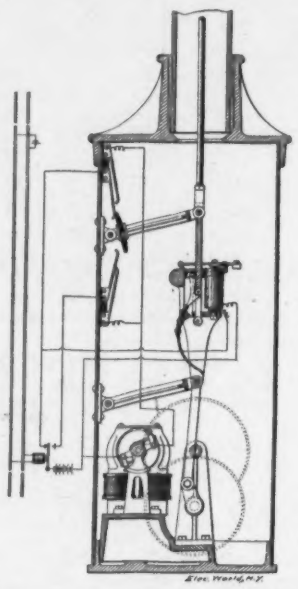
[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

614,794. CIRCUIT BREAKER; W. I. Crawford, of St. Louis, Mo. App. filed Aug. 23, 1897. In a circuit breaker, the combination of a standard, an armature, a clamp for connecting the stem of the armature in the standard, a set screw having a threaded connection with the standard, and an adjusting screw having a headed connection with the clamp, substantially as described.

614,819. PROCESS OF AND APPARATUS FOR COVERING WIRE WITH ASBESTOS; E. Albasini, of Turin, Italy. App. filed May 28, 1898. An apparatus for applying fibrous asbestos to wire, comprising means for applying a gradually increasing pressure to the asbestos, substantially as described.

614,839. METHOD OF FORMING ELECTRICAL CONNECTIONS; William B. Cleveland, Cleveland, Ohio. App. filed May 9, 1898. The method of joining two members of copper to form an electric connection, consisting of, first, casting one member upon the other, heating the two contiguous surfaces to a welding heat while free from atmospheric contact; second, supporting the casting in a die to prevent distortion, and third, uniting the two members by applicadtion of pressure while they are at a welding temperature and free from contact of atmospheric air.

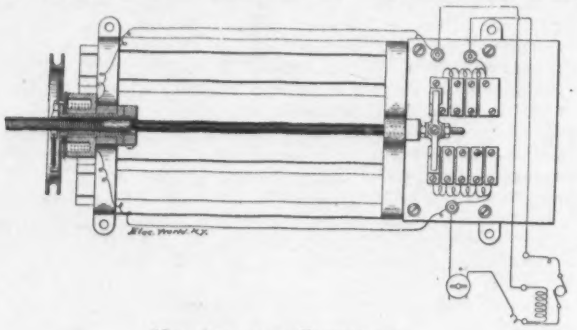
614,875. TROLLEY FOR ELECTRIC CARS; H. W. Libbey, of Boston, Mass. App. filed Jan. 11, 1898. A trolley head having two arms, between which the main trolley wheel is mounted and a bracket on each side, between which and one of the arms is mounted a small contact wheel or roller.



No. 614,914.—MECHANISM FOR CONTROLLING ELECTRIC CIRCUITS.

614,882. JUNCTION BOX; T. J. Murphy, of New York, N. Y. App. filed April 22, 1895. A box for mounting and connecting electrical conductors, comprising an exterior wooden shell, a lining of a refractory, non-conducting material therefor, a cover provided with a similar lining, and a screw nipple or nipples extending through said wooden shell against the lining, said lining being countersunk and receiving a washer, with a washer on the outside of the wooden shell.

614,914. MECHANISM FOR CONTROLLING ELECTRIC CIRCUITS; G. H. Whittingham, of Baltimore, Md. App. filed April 5, 1898. In mechanism for controlling electric circuits, the combination of a movable device which immediately controls or affects the circuit; a screw which imparts motion to said device; a pulley wheel carrying a lever which is adapted to engage the threads of said screw and thereby move it endwise in one direction, and means to place the lever in engagement with the screw.



No, 615,142.—SIGNALING.

614,941. TROLLEY DEVICE; J. C. Fernald, of Philadelphia, Pa. App. filed April 19, 1898. In a trolley, the combination of the trolley pole, a loosely jointed section connected to the pole on a transverse axis or hinge, a frame pivoted upon the upper end of the jointed section upon a vertical axis, two grooved contact wheels journaled one upon each end of said frame, and means independent of the pole consisting of a V-shaped shoulder and socket carried by the jointed section and frame for normally causing the wheels of said frame to lie in the plane of the pole and jointed section.

614,946. TELEPHONIC MICROPHONE; W. D. Gharky, of Philadelphia, Pa. App. filed Dec. 20, 1897. A telephonic microphone having a positive electrode of high thermo-electric value and a negative electrode of relatively low thermo-electric value.

614,964. DYNAMO-ELECTRIC MACHINERY; J. S. Lewis and F. J. Howitt, of Manchester, England. App. filed March 12, 1898. In a multipolar dynamo-electric machine, a field magnet comprising an outer magnet ring, inwardly projecting radial magnet cores secured to said ring, and annular plates of non-magnetic metal secured to said ring and to the cores, substantially as described.

614,982. AUTOMATIC TIME ELECTRIC-CIRCUIT SWITCH; F. Richard, of Boston, Mass. App. filed Oct. 30, 1897. The combination, with any number of open electric circuits, of a clock having a rotary dial furnished with adjustable pins adapted to engage the teeth of a toothed wheel, and during such engagement to rotate such wheel, and a switch having said toothed wheel adapted for such engagement and rotation, and furnished with arms adapted by said rotation to be brought into contact with and close any or all of said electric circuits, and to be carried out of such contact and open any or all closed electric circuits, substantially as described.

614,995. UNDERGROUND CONDUIT FOR ELECTRICAL CONDUCTORS; C. H. Sewall, of Chicago, Ill. App. filed March 2, 1898. The combination with a foundation having formed upon the surface thereof a continuous floor of indefinite width and length, of an inverted channel or block resting thereon, and having a plurality of conduit grooves therein, substantially as described.

615,014. REPEATER; W. M. Chapman, of Needham, Mass. App. filed March 17, 1898. In a signaling mechanism, the combination with a signal recording and transmitting device of a series of movable recording parts for said recording device, and a movable part for said transmitting device having secured thereto the roll, the pawl, the bell-crank lever and the rod, the roll and the pawl being adapted to co-operate with the movable recording parts, substantially as described.

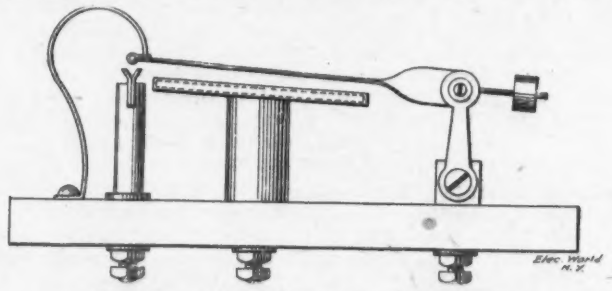
615,057. ELECTRO-MECHANICAL STRIKING MECHANISM; C. E. Beach and H. W. Doughty, of Binghamton, N. Y. App. filed Sept. 8, 1896. Magnets, an armature influenced thereby, a notch or projection moving with said armature, an actuating wheel engaging with the notch or projection, and an arm operated by said actuating wheel, and arranged to operate the armature for the purpose described.

615,136. ELECTRIC METAL-HEATING PROCESS; George D. Burton, Boston, Mass. App. filed Aug. 24, 1893. The art of heating metal bars, which consists in subjecting the parts to be heated while in contact with each other to the action of an electric arc sprung between them and an electrolytic bath.

615,142. SIGNALING; J. P. Coleman, of Edgewood Park, Pa. App. filed Jan. 3, 1898. In a signal apparatus, the combination of a signal, an electric motor for shifting the signal to clear and danger positions by rotation in the same direction, a circuit through said motor, two make-and-break mechanisms included in said circuit, said make-and-break mechanism being, respectively, adapted to be opened and closed by the movements of the signal to and from clear position.

615,172. PRIMARY BATTERY; H. K. Hess, of Philadelphia, Pa. App. filed Feb. 2, 1898. A section of a primary battery consisting of two side plates composed of a frame cast around thin plates of porous carbon, with strips of lead mounted between the two side plates and fused thereto, substantially as described.

615,186. ELECTRIC SAFETY DEVICE; J. F. Kelly, of Pittsfield, Mass. App. filed April 14, 1898. In a system of distribution by alternating currents, the combination of a transformer, a normally open local circuit having both its terminals electrically connected to said transformer, an electrostatically operated device closing said local circuit upon the passage of current from the primary to the secondary circuit of said system, and a circuit interrupting device operated as a consequence of the current flowing in said local circuit when closed.



No. 615,186.—ELECTRIC SAFETY DEVICE.

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